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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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A Survey of Hodgkin's Disease and Lymphosarcoma in Bone[1]

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SINCE ZIEGLER'S original description in 1911 of involvement of the osseous system in Hodgkin's disease (33), numerous reports have accumulated on skeletal changes in the lymphomatoid diseases. The literature, which has been summarized by Uehlinger (31), Craver and Copeland (5), and Dresser and Spencer (9), indicates that the osseous lesions in the lymphomas are of considerable clinical importance and therefore merit careful attention. The data and conclusions presented in this study have their basis in a review of 38 cases of Hodgkin's disease and 15 cases of lymphosarcoma, all of which have shown definite roentgenologic evidence of skeletal changes. In addition to considering the specific features of the osseous lesions, an effort has been made to relate these findings to the clinical course of the disease.

In early reports, Hodgkin's disease and lymphosarcoma of bone were frequently considered together. Here, a rigid separation of the two groups (criteria based on histology of co-existing lesions) has been attempted in order to permit a comparison and evaluation of their common features. The salient points have been brought into bold relief by considering them individually.

INCIDENCE

Considerable confusion exists in the published reports as to the exact incidence of bone involvement in Hodgkin's disease and lymphosarcoma. This is illustrated by Table I, recording the incidence in the more extensive reviews which have been published. The differences shown in the table can be resolved in part if we consider the type of analysis (*e.g.*, roentgenographic or postmortem), thoroughness of the examination, and the character of the osseous involvement. With respect to the character of the skeletal involvement, it is necessary to differentiate carefully between changes in bone marrow and in the bone cortex. It is accepted that bone marrow involvement occurs terminally in practically all cases of Hodgkin's disease (Ewing, 10). Definite cortical bone destruction, however, represents an entirely different phase of osseous involvement and should be examined separately. In lymphosarcoma, although few data have been published with respect to incidence, discrepancies

[1] From the Medical Service, Memorial Hospital, New York, New York. L. F. Craver, M.D., Attending Physician. Presented before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

TABLE I: INCIDENCE OF OSSEOUS INVOLVEMENT IN HODGKIN'S DISEASE AND LYMPHOSARCOMA

Authors	Hodgkin's Disease			Lymphosarcoma		
	Number of Cases Reported	Number of Cases with Bone Lesions	Incidence (Percentage)	Number of Cases Reported	Number of Cases with Bone Lesions	Incidence (Percentage)
Baldridge and Awe (2)	46	6	13			
Burnham (4)	173	2	1.1			
Dresser (1926) (8)	95	4	4.2			
Dresser (1931) (7)	149	16	10.7			
Kimpel and Belot (16)	33	4	12.1			
Kremser (17)	51	2	3.9			
Dresser and Spencer (9)	149	16	10.7			
Craver and Copeland (5)	172	27	15.7	164	17	10.4
Uehlinger (31)	50	17	34			
Authors' series	257	38	14.8	213	15	7

as great as those found in Hodgkin's disease are not to be expected. As will be noted later, in an osseous focus in lymphosarcoma cortical destruction is of rapid development. The discrepancy, therefore, between bone marrow involvement at necropsy and cortical changes found roentgenologically will not be as pronounced as in Hodgkin's disease.

Postmortem Studies: In order to compare the findings postmortem and those made roentgenographically during life, the routine autopsy protocols of 47 cases of Hodgkin's disease and 54 cases of lymphosarcoma were reviewed. In Hodgkin's disease 23 of 47 cases (49 per cent) were found to have skeletal lesions. In lymphosarcoma, 16 of 54 cases (29 per cent) had skeletal disease. It must be emphasized that these figures by no means accurately reflect the incidence of osseous involvement to be found postmortem, since the examinations of the skeleton were inadequate, being limited to easily accessible bones or in some cases omitted entirely. The figures representing the incidence in this particular group of cases are probably much too low.

In the 23 cases of Hodgkin's disease with skeletal lesions, only 8 (34 per cent) had continued on to actual cortical destruction, while in lymphosarcoma 10 of the 16 (63 per cent) cases showed true bone destruction. It appears from these figures that cortical destruction is more likely to be a feature of osseous involvement in lymphosarcoma than in Hodgkin's disease. When cortical destruction occurs, bone marrow involvement is almost always present. However, if bone marrow lesions can be demonstrated, cortical destruction is not necessarily found. Bone marrow involvement alone, without cortical destruction, was found in 15 of 23 cases of Hodgkin's disease and in 6 out of 16 cases of lymphosarcoma.

Roentgenologic Studies: In a review of 257 cases of Hodgkin's disease, roentgenographic evidence of bone involvement was found in 38 cases (14.8 per cent). A similar study of 213 cases of lymphosarcoma demonstrated roentgenographic evidence of bone changes in 15 cases (7 per cent). These figures probably do not truly reflect the incidence in Hodgkin's disease and lymphosarcoma and are undoubtedly too low. The factors which contribute to a low incidence on roentgenographic examination are:

(1) At present the investigation of the osseous system is frequently inadequate or completely ignored, since the tendency to refer all symptoms to lymphatic system disease postpones thorough study of the skeleton.

(2) As in the postmortem examinations, investigation of the skeletal system is too limited in scope, since the roentgenographic

examinations are made only after symptoms become unusually prominent. A number of cases undoubtedly are not examined because of the absence or paucity of symptoms or physical findings.

(3) Roentgen examination reveals lesions only after the disease process has extensively involved the bone marrow and spongiosa or has progressed to cortical destruction.[2] On the other hand, when a contiguous lesion directly invades bone, roentgenographic evidence is present early since the cortex is affected first.

Several investigators have shown that far-advanced lesions were found at necropsy but not detected on roentgenograms. Reisner and Brada (25) report a case in which roentgenograms of the spine were negative but at postmortem there was very extensive disease histologically. Herscher (12) reported a similar case in which marked destruction in the ribs and the spine was present at necropsy though no evidence of disease was found in roentgenograms made two weeks previously. Unfortunately, the roentgenograms were not published. Adherence to those technical factors which provide the greatest bone detail, and definition, would probably eliminate a number of discrepancies. As noted previously, however, absence of cortical bone destruction will make roentgenologic detection of most of the lesions very difficult.

From a review of our data in regard to the types of lesions (described later) and from findings at autopsy, it appears that a more representative idea of the incidence is obtained by roentgenography in the lymphosarcoma series than in the cases of Hodgkin's disease. This belief rests primarily upon evidence that in lymphosarcoma cortical bone destruction develops rapidly and extensively from a focus in the spongiosa, whereas in Hodgkin's disease a much longer interval between deposit of a metastatic focus in bone and actual destruction may exist.

[2] Snure and Maner (29), among others, have shown that destruction of bone marrow and spongiosa may proceed to a considerable degree before definite roentgenographic evidence is present. Certainly in the vertebrae the spongiosa may be almost entirely replaced without sufficient evidence to warrant a definite diagnosis.

SYMPTOMS, CLINICAL AND LABORATORY FINDINGS

Indications for roentgenography in an attempt to localize areas of osseous disease depend almost entirely on symptoms and findings, which may be summarized in the following general categories:

(1) *Localized Pain and Tenderness:* Pain and tenderness, early and persistent findings, were the most frequently encountered changes in both Hodgkin's disease and lymphosarcoma. The relation of pain to actual bone disease was obscured in many instances by symptoms produced by regional lymph node involvement. Tenderness to pressure, however, appeared to be a more reliable criterion and, when pronounced, usually indicated bone destruction. In general, the symptoms and findings were more acute in lymphosarcoma than in Hodgkin's disease.

(2) *Swelling or Palpable Mass:* Evidence of swelling or palpable mass was frequently associated with bone destruction. This occurred most commonly in the ribs and sternum, less frequently in the long bones. The masses were usually tender to palpation.

(3) *Neurological Findings:* Infiltration from contiguous disease in the spine into the spinal canal with resultant neurological signs was often present with or without evidence of collapse of the vertebral bodies. The findings were similar to those produced by other types of segmental involvement of the spinal cord.

(4) *General Constitutional Changes.* In both lymphosarcoma and Hodgkin's disease the constitutional changes seem to differ in no important respect from those of patients in whom no skeletal changes could be demonstrated. Changes in the hemogram due to injury of the hematopoietic system appeared more frequently in Hodgkin's disease than in lymphosarcoma. This was to be expected since the multiplicity of osseous lesions was greater in Hodgkin's disease than in lymphosar-

coma. Evaluation of the blood examinations was difficult, however, because of the complicating factor introduced by radiation therapy. For this reason detailed analyses of blood studies were not done.

Elevated Serum Phosphatase Levels Indicating Altered Bone Metabolism: Abnormal serum phosphatase values in Hodgkin's disease and lymphosarcoma may give some help in deciding whether pain referred to bone is actually due to osseous disease. In the light of recent work, it appears that an elevated serum phosphatase often occurs when osseous disease is present. Woodard and Craver (32) have shown that elevated phosphatase occurred in Hodgkin's disease in 14 of 19 cases with bone lesions demonstrated by x-ray. Twenty-one of 36 patients with bone symptoms but without roentgenographic evidence of bone destruction also had elevated serum phosphatase levels. In lymphosarcoma, 5 of 8 patients with bone symptoms and negative x-ray films had elevated serum phosphatase and 3 of 9 patients with roentgen evidence of osseous lesions had elevated values.

In our series, 18 of 38 patients with Hodgkin's disease of bone had serial determinations of phosphatase activity. Of these, 9 had serum phosphatase values above 5.5 Bodansky units. In these cases with definite elevation, the bone lesions were found to be of the mixed variety, showing both osteoplastic and osteolytic changes, with the osteoplastic reaction usually predominant. In the 9 cases in which no elevation was noted, the bone lesions were predominantly osteolytic in 6 and osteoplastic in 3. In the 3 cases with osteoplastic reaction, the disease was not extensive and the progress of the lesions was slow. This may account for the failure to find an elevated serum phosphatase in this group.

In the lymphosarcoma series, 5 of the 15 patients examined had serum phosphatase estimations. In this group, 2 of the patients with elevated values had lesions which were predominantly osteoplastic. The 3 patients without increased values had osteolytic lesions with little or no osteoplastic reaction.

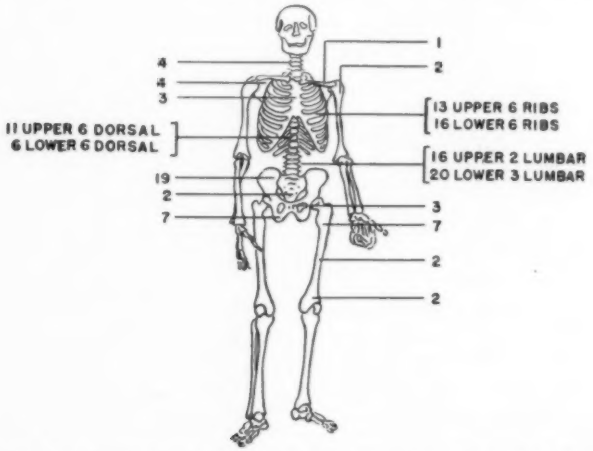


Fig. 1. Distribution of skeletal lesions in 38 cases of Hodgkin's disease.

It appears that an increase of serum phosphatase values in cases of bone involvement in Hodgkin's disease and lymphosarcoma would indicate that osteoplastic changes will frequently be found roentgenographically. It is generally accepted that an elevation in the alkaline serum phosphatase level is due to a liberation of the enzyme from bone if severe liver damage or jaundice of hepatic origin can be ruled out. Elevated phosphatase values,

therefore, reflect any abnormal osteoblastic activity roughly proportional to the extent and intensity of ossification by the osteoblastic cells (11). When destructive and reparative processes occur simultaneously, the process of repair alone is reflected in the phosphatase activity. Lesions which are wholly destructive (*e.g.*, myeloma) produce little or no phosphatase activity.

MODE OF INVOLVEMENT

Involvement of bone in Hodgkin's disease and lymphosarcoma occurs by direct extension from adjacent affected lymph nodes or by the hematogenous route to distant bone sites. Bone involvement by these two routes has been recognized for some time in Hodgkin's disease and was thoroughly reviewed by Uehlinger. In his series, he found that in 12 of 17 cases with osseous changes the skeletal lesions were due to direct extension. In the remaining 5, the bones were involved by hematogenous spread. These figures are based on postmortem studies which were apparently limited to the easily accessible parts of the skeletal system. From analysis of the character of the bone changes reported here and a review of the autopsy protocols described previously, there is evidence which strongly suggests that spread by the hematogenous route occurs more extensively than by direct extension. In this series, the usual roentgenologic features (character of cortical destruction, involvement of contiguous bones from external foci, site, etc.) were the criteria used in judging between direct and hematogenous extension. In lymphosarcoma, hematogenous extension to bone appeared even more frequently than in Hodgkin's disease.

Examination of the autopsy protocols of 56 cases of lymphosarcoma and 47 cases of Hodgkin's disease provides evidence suggesting that in the hematogenous route of extension an embolus first lodges in the spongiosa or marrow. By a process of extension, the cortical portion of the bone is then involved. As in other metastases, the clinical findings and roentgenologic evidence depend to a marked degree on the extent of this cortical involvement. The regions in which red bone marrow is most prevalent (*e.g.*, vertebrae, ribs, pelvis, and femora) were more frequently affected in Hodgkin's disease and lymphosarcoma, closely paralleling the distribution of osseous metastases in carcinoma.

No case of this series of Hodgkin's disease with bone involvement was considered to

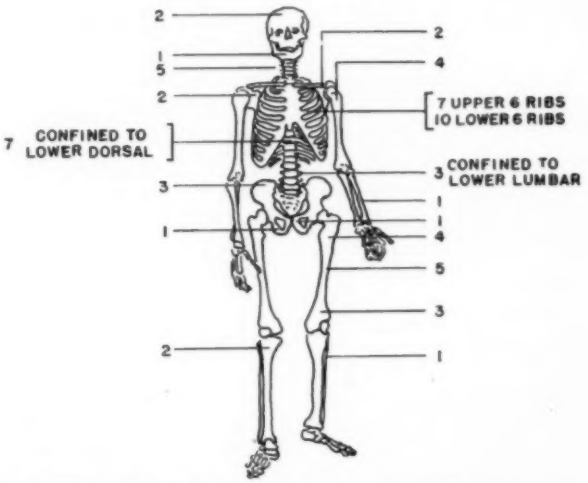
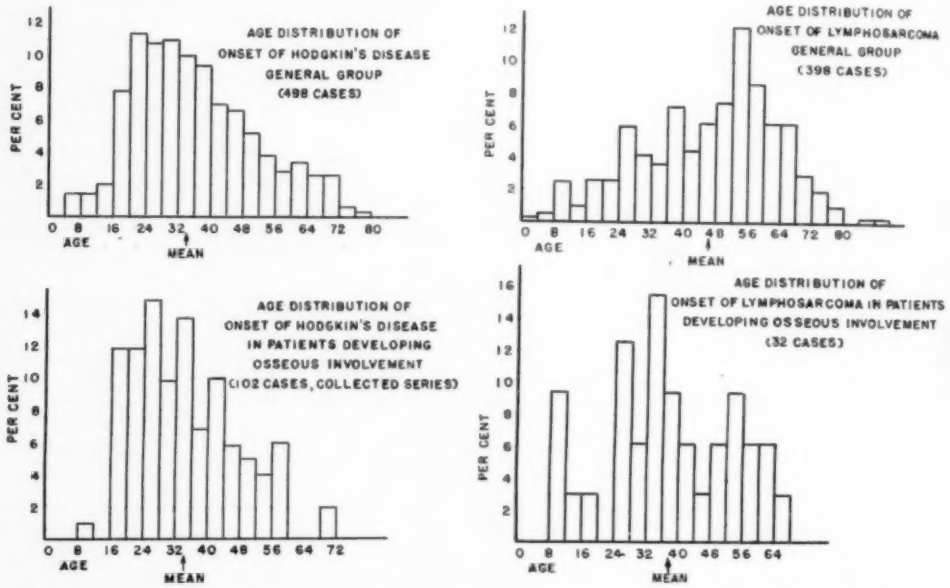


Fig. 2. Distribution of skeletal lesions in 15 cases of lymphosarcoma.

have its inception in the bones, although it has been reported that osseous lesions may initiate the disease process (8, 21, 30). Very rarely, in Hodgkin's disease of bone, lymph node involvement cannot be demonstrated. Livingston (19) reported bone invasion by Hodgkin's disease in a case in which the disease was otherwise limited to liver and spleen. Krumbhaar (18) described a case with only splenic disease and 398 patients with lymphosarcoma (with positive histological diagnosis) were analyzed for the age at which the diagnosis was made. Figures 3 and 4 graphically illustrate these data. In Figure 3, showing the age distribution of the general group of 498 cases of Hodgkin's disease, the peak is found to lie between the twentieth and the twenty-fourth years and the mean to lie between thirty-two and thirty-


AGE DISTRIBUTION OF ONSET OF HODGKIN'S DISEASE GENERAL GROUP (498 CASES)
PER CENT
AGE
MEAN
AGE DISTRIBUTION OF ONSET OF LYMPHOSARCOMA GENERAL GROUP (398 CASES)
AGE DISTRIBUTION OF ONSET OF HODGKIN'S DISEASE IN PATIENTS DEVELOPING OSSEOUS INVOLVEMENT (102 CASES, COLLECTED SERIES)
AGE DISTRIBUTION OF ONSET OF LYMPHOSARCOMA IN PATIENTS DEVELOPING OSSEOUS INVOLVEMENT (32 CASES)

Figs. 3 and 4. Age distribution of onset of disease in patients with Hodgkin's disease and lymphosarcoma, with and without osseous lesions.

and bone marrow foci. Herscher (12) reported a case showing only marrow and liver involvement. No authentic example of supposed primary Hodgkin's disease of bone without concomitant disease in the liver, spleen, or lymph nodes has been reported.

Since we did not wish to consider the primary reticulum-cell sarcoma of bone described by Parker and Jackson (23), no case which had its inception in bone was included in the lymphosarcoma group.

AGE INCIDENCE

From the files of the Memorial Hospital, records of 498 patients with Hodgkin's six years. In a similar analysis of 102 collected cases (Fig. 3) of Hodgkin's disease of bone (present series, 38 cases; Craver and Copeland, 27 cases; Dresser, 20 cases; Uehlinger, 17 cases), a distribution similar to the general group is apparent. In this series the peak occurred in the twenty-four to twenty-eight-year group with the mean lying between thirty-two and thirty-six years. Thus, there appears to be no significant difference in the age distribution of the two groups.

A similar analysis in lymphosarcoma shows results which are significantly different (Fig. 4). In the entire group of 398 cases, the peak occurred in the fifty-two

to fifty-six-year group and the mean was approximately at forty-eight years. In those patients with bone lesions, the distribution according to age was decidedly altered—the peak occurring in the thirty-two to thirty-six-year group and the mean at thirty-seven years. Although we have data on only 32 cases of lymphosarcoma with bone disease, the difference between the two groups appears significant.

Comparison of the two sets of histograms (Figs. 3 and 4) provides information which might not be readily evident from the data. It is apparent that the distribution of the age of onset in Hodgkin's disease is quite different from that of lymphosarcoma. In Hodgkin's disease the curve appears to rise abruptly in the period following puberty, whereas in lymphosarcoma there is a gradual increase to a peak which is well over fifty years. It also appears evident that bone lesions in patients with lymphosarcoma affect those persons in whom the disease is found at an earlier age than in the general group. No such relation is noted in patients with bone lesions due to Hodgkin's disease.

TIME OF OCCURRENCE OF BONE LESIONS WITH REFERENCE TO SPAN OF THE DISEASE

It has been the general impression that in Hodgkin's disease the appearance of bone lesions is usually a late event, indicating that the terminal stage is approaching. In an attempt to determine at what point during the course of the disease the osseous lesions occur, we reviewed 19 cases previously reported by Craver and Copeland and 25 cases in the present series—a total of 44 cases which were followed from inception of the disease until death. Analysis of these data appears to lend no support to the opinion generally held heretofore. Although in most cases bone involvement occurred after the halfway mark, 37 per cent of the patients showed osseous lesions before one-half of the course of the disease had elapsed, and in only 31 per cent did these develop in the last third of the course. Dresser and Spencer also noted that 25 per cent of their patients had early skeletal manifestations. Figure 5 graphically illustrates the data. The total duration of the disease has been considered as 100 per cent in each case and the incidence of bone involvement has been plotted accordingly. It might be argued that data considered in this manner may mask the fact that Hodgkin's disease with lesions of bone has only a short course in any event. This is evidently not the case, as is shown in Figure 6, which will be discussed later. In the 44 cases considered

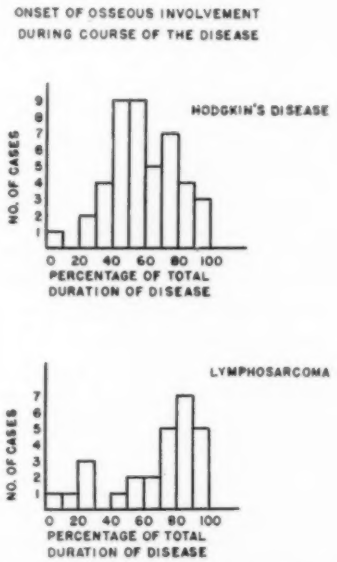


Fig. 5. Comparison of onset of lesions in Hodgkin's disease and lymphosarcoma.

here it was found that the average duration of life after the occurrence of bone lesions was 17.6 months.

In analyzing, in a similar manner, 27 cases of lymphosarcoma with bone disease, quite different results were obtained, in closer conformity to the general impression. In only 22 per cent of the patients did bone lesions develop in the first half of the span of the disease, while in 63 per cent bone involvement appeared in the final third of the course. These data coincide well with the short average survival period after the appearance of bone

lesions in lymphosarcoma. The average survival was found to be only 5.8 months. It would thus seem that the appearance of bone lesions in lymphosarcoma probably indicates the terminal stage.

The data are best interpreted to mean that occurrence of lesions of bone in Hodgkin's disease alters prognosis as to expectancy considerably less than the appearance of bone invasion in lymphosarcoma. It does not mean, however, that patients with lymphosarcoma who develop bone lesions will have, or have already had, a shorter course than those who show no definite evidence of bone disease (see Fig. 7).

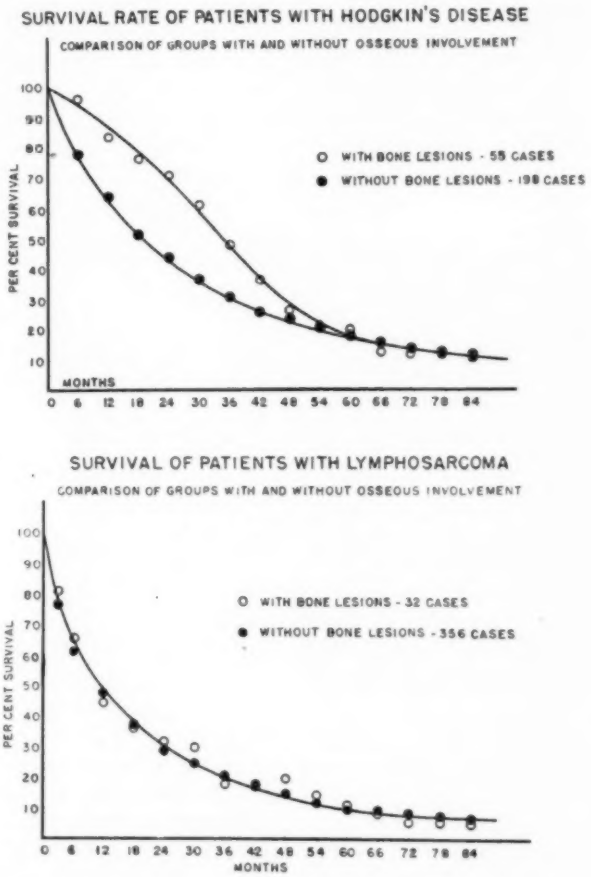
SURVIVAL RATE

The period of survival has been studied in 198 cases of Hodgkin's disease without bone lesions (from data published by Slaughter and Craver, 28) and 64 cases of Hodgkin's disease of bone. For comparison, the curves were made according to methods described by Jacobs (13, 14) and Welch and Nathanson (22). The figures used to establish the curve shown in Figure 6 include all cases with positive biopsies and acceptable to the Memorial Hospital for study or treatment, or both. Selection of cases for compilation of these curves was not affected by any other factors. It is readily apparent that the survival of patients with osseous disease differs considerably from that of patients without demonstrable bone lesions. Up to the five-year follow-up, there are definitely more patients alive who have or will have bone disease. Beyond the five-year period, the rate of survival, and therefore the life expectancy, remains about the same in both groups. It is to be noted that only 18 per cent are alive at the end of five years, whether or not skeletal disease has developed. From inspection of the curves, it is apparent that the average survival is greater in those patients having bone lesions and that the greatest difference exists in the first few years after the onset of the disease. A first hypothesis for the findings noted previously would postulate that those patients who survive for long periods of time finally develop bone lesions. Only very slight support is available for this contention, however, since Figure 5 shows that 37 per cent of the patients developed bone lesions in the first half of the course. From the available data it would be difficult to establish a direct causal relationship between the improved average survival and the development of bone lesions. It is probable that the occurrence of bone involvement and longer survival are related to a third factor or group of factors which is not evident from our data and remains in the realm of speculation. Review of the clinical features and histological characteristics of the biopsy specimens have been uninformative as to these unknown factors.

Analysis of the survival rate of lymphosarcoma with and without bone lesions is more easily interpreted. The survival curve for patients without bone disease and for patients with bone lesions was constructed in the same way as for Hodgkin's disease. The only criteria used in compiling these figures were positive biopsy and admission to the Memorial Hospital clinic for study or treatment, or both. The rate of survival for both groups coincides well throughout the follow-up period. The five-year survival is about 11 per cent (see Fig. 7). If the curves of the survival rates for lymphosarcoma and the data presented in Figure 5 are related, it may be stated that the onset of bone lesions does not occur in any special group with respect to length of survival. Figure 5 shows that in lymphosarcoma bone lesions occur near the end of the span of the disease (in 63 per cent bone lesions develop in the final third of the course), while Figure 7 indicates that patients who develop bone lesions have practically the same survival as those without bone involvement. As noted previously, one must be led to the conclusion that the appearance of bone invasion usually means that termination of the disease span is approaching, but does not mean that the course has been more rapid than in patients without bone lesions.

SITE OF LESIONS

Figures 1 and 2 present a general survey of the site of osseous metastases in Hodgkin's disease and lymphosarcoma. The observations coincide with data published by others and again demonstrate that the pelvis, vertebrae, ribs, and femora are most frequently involved. In this study, the wings of the iliac bones appeared to be affected more frequently than any other single site. In lymphosarcoma, distribution of lesions was more general, although a preponderance of the bone changes occurred in the bones listed. Uehlinger found 62 per cent of all the bone lesions of Hodgkin's disease to be in the vertebral column. This differs considerably from our figure and may be in part accounted for by the fact that involvement of the bone marrow, either with or without cortical destruction, was included in his series. The distribution of the osseous changes due to Hodgkin's disease in the vertebrae have been reported by Uehlinger to coincide closely with those in tuberculosis. This is of doubtful significance, since it has been shown by Jenkinson (15) that the distribution of bone metastases from various malignant tumors coincides fairly well with the skeletal deposits from the


SURVIVAL RATE OF PATIENTS WITH HODGKIN'S DISEASE
COMPARISON OF GROUPS WITH AND WITHOUT OSSEOUS INVOLVEMENT
PER CENT SURVIVAL
MONTHS
O WITH BONE LESIONS - 55 CASES
● WITHOUT BONE LESIONS - 198 CASES
SURVIVAL OF PATIENTS WITH LYMPHOSARCOMA
COMPARISON OF GROUPS WITH AND WITHOUT OSSEOUS INVOLVEMENT
PER CENT SURVIVAL
MONTHS
O WITH BONE LESIONS - 32 CASES
● WITHOUT BONE LESIONS - 356 CASES

Figs. 6 and 7. Survival rates in Hodgkin's disease and lymphosarcoma with and without bone involvement.

lymphomatoid diseases. It is probable that the vascular arrangement in the vertebra is such that embolic phenomena are common at certain sites.

In the 38 cases with bone lesions of Hodgkin's disease, 24 (65 per cent) showed involvement of multiple bones, and in 14 (35 per cent) only single bones could be determined roentgenographically to harbor disease. In 13 of the 24 cases with lesions in multiple bones, 5 or more bones were sites of osseous change. In 14 cases with single bone involvement the most common sites were vertebrae, sternum and ribs, the sternum being affected in 3 of these cases by direct extension. The distribution of the other single lesions was not unlike that found in those cases with multiple lesions. Of the 15 patients with lymphosarcoma with bone disease, 9 (60 per cent) had multiple bones affected. Of these 9 patients, only 2 had disease in 5 or more bones. In 3 of the 6 cases with involvement of only a single bone, the lesions were found in the femur. These figures indicate the marked tendency to multiplicity of bone lesions and emphasize the necessity for careful study of other bones once the presence of any skeletal change has been established.

CHARACTER OF BONE LESIONS

In 38 cases of Hodgkin's disease with bone destruction, 144 bones showed roentgenographic evidence of disease. The lesions were more often multiple than single and had definite sites of predilection (Fig. 1).

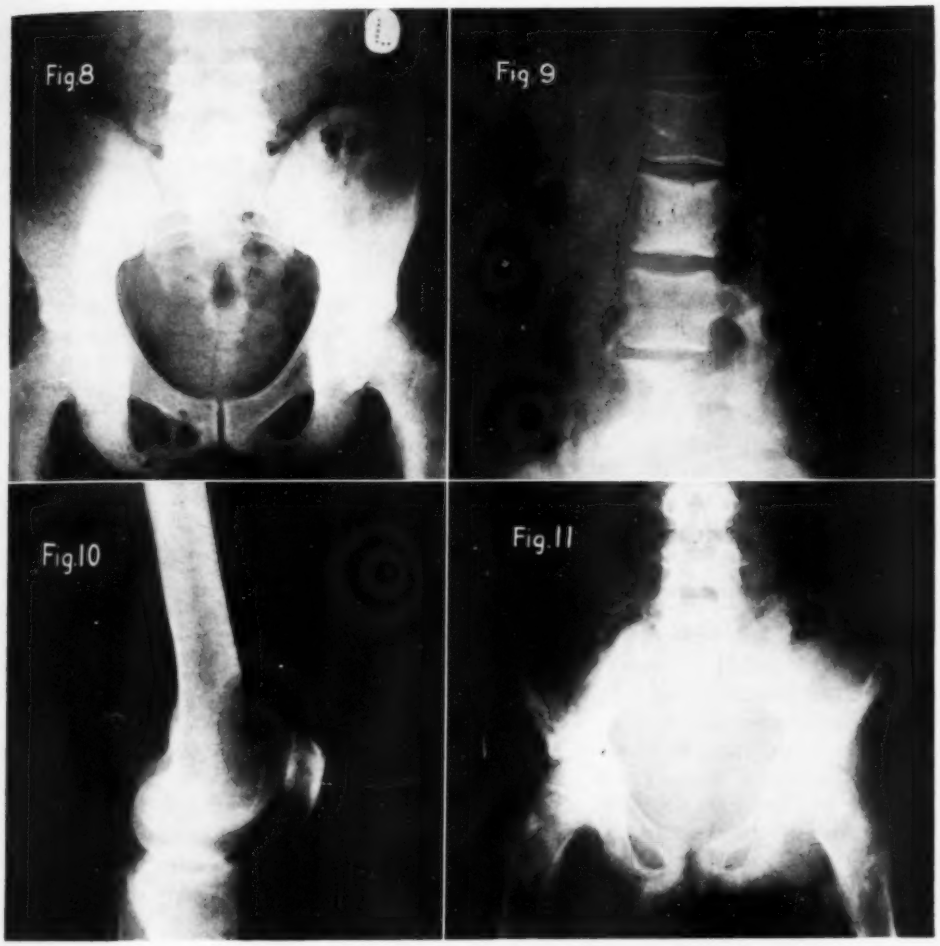
The character of the individual lesions was distinctive but not pathognomonic and they could readily be confused with a variety of other conditions. Osteolytic, osteoplastic, or a combination of osteolytic and osteoplastic changes were present. Fifty-eight per cent of the lesions were of the mixed variety, both osteoplastic and osteolytic; 28 per cent were entirely osteolytic; 14 per cent were purely osteoplastic. The mixed lesions were irregular in outline and the margins showed either gradual transition into or sharp demarcation from surrounding normal bone. The osteosclerotic changes were either diffusely interspersed through the areas of bone destruction or were found at the margins of the bone lesions. When the sclerotic changes occurred at the periphery, they served to demarcate the disease process sharply from the normal bone (Fig. 8).

As in other neoplastic conditions, the cartilaginous surfaces and intervertebral discs resisted invasion. In several cases, hypertrophic spurs originating on the surface of the vertebral bodies were found to be involved by the disease. Such a case is shown in Figure 9.

The purely osteolytic lesions were about half as numerous as those showing a combination of osteolysis and osteosclerosis. Although this type of lesion appeared at all sites, it was present more frequently in the flat bones (wings of the ilia, sternum) and ribs. The lesions here were less sharply circumscribed than those in the mixed group, although osteolytic lesions in ribs were more sharply demarcated than a similar type of lesion elsewhere. The osteolytic changes were often accompanied by expansion of bone. This again was most frequent in the ribs and was also encountered in the sternum. The areas of destruction were rarely discrete, being more commonly diffuse in nature.

Purely osteoplastic changes were encountered least frequently—12 per cent of all lesions. They were most common in the vertebrae, especially in the bodies of the lumbar spine. Occasionally a single vertebral body was the seat of osteoplastic change, but more often several vertebrae were affected. This type of lesion was less common in the pelvis and was rarely found in the ribs. In a number of cases, purely osteoplastic changes gave way to actual destruction and osteolysis. It is not certain that all sites of osteoplasia would not have undergone the same fate eventually. On roentgen examination the involved bone shows the presence of very dense areas similar to the dense bone found in other diseases.

Periosteal reaction occurred in several



Figs. 8–11. Bone lesions in Hodgkin's disease and lymphosarcoma.

Fig. 8. Hodgkin's disease invading the pelvic bones: typical osteolytic foci with osteosclerotic margins.

Fig. 9. Hodgkin's disease of lumbar spine with extension into hypertrophic spurs. Note also the combined osteolysis and osteoplasia in the bodies of the vertebrae.

Fig. 10. Lymphosarcoma involving the lower portion of the bone. Note complete dissolution at site of involvement.

Fig. 11. Diffuse osteolytic and osteoplastic bone invasion in lymphosarcoma, extending through all the bones of the pelvis and the upper femora.

cases. This was only moderate in degree, was never lamellated, and occurred primarily in the long bones. These changes were also observed in the sternum and the ribs. The periosteal reaction was never found to occur alone.

The various types of lesions described were often encountered in the same person. In a number of cases, however, there appeared to be a definite pattern, the lesions being predominantly osteolytic or osteoplastic. Fractures were encountered primarily in the ribs and vertebrae. The vertebral lesions were of the compression type but did not appear to progress to extensive destruction as often occurs in vertebral invasion by metastatic carcinoma. In no instance was complete collapse of the vertebral body found. The fractured ribs were similar in character to

those encountered in other disease processes.

In several patients, peculiar calcified deposits were observed about the vertebral bodies, especially along the anterior longitudinal ligaments. Calcification often proceeded at a rapid rate, occurring at times within a space of three months. Although hypertrophic changes were present in the vertebral bodies in some of the cases, calcification of the ligaments appeared to be unrelated to any such process. The changes occurred after radiation therapy, and it is possible that the calcification took place in ligaments involved by the disease.

The character of the bone change in lymphosarcoma differed considerably from that found in Hodgkin's disease. By contrast, the lesions were almost entirely osteolytic (85 per cent), but the mixed variety, showing both osteolytic and osteoplastic features, was also present, occurring in 10 per cent; 5 per cent of the lesions were purely osteoplastic. As in Hodgkin's disease, the lesions were more frequently multiple. They were not as numerous as in Hodgkin's disease, although they were distributed more widely among the various bones. The osteolytic lesions in most cases were locally more extensive and much more invasive than those observed in Hodgkin's disease and produced almost complete dissolution of the affected portion of the bone (Fig. 10). Generally, it may be stated that in lymphosarcoma the roentgenograms suggested rapid destruction of bone, while in Hodgkin's disease the infiltrations in bone were more gradual and long-continued. The purely osteoplastic changes which occurred in lymphosarcoma were noted in the lumbar vertebrae, and the character of the process was similar to that of the osteoplastic reactions observed in Hodgkin's disease. All purely osteoplastic changes were encountered in the same individual—in sharp contrast to the observations made in Hodgkin's disease.

Pathologic fractures were encountered in the vertebrae, ribs, and pelvis. In the vertebrae, compression of the bodies was much more complete than in Hodgkin's disease and was undoubtedly associated with a more extensive dissolution of bone. Periosteal reactions, more frequently encountered in lymphosarcoma than in Hodgkin's disease, occurred entirely in the long bones. The periosteal changes appeared to be more marked in lymphosarcoma as well. In lesions showing combined osteoplastic and osteolytic changes, the character of the bone involvement was considerably different from that encountered in Hodgkin's disease. The lesions of bone of this type in lymphosarcoma were extensive, and sharp demarcation from normal bone, often seen in Hodgkin's disease, was not observed (see Fig. 11).

The material presented here clearly indicates the distinctive features of the osseous involvement in lymphosarcoma and in Hodgkin's disease; yet absence of pathognomonic signs makes a clear-cut separation of the two groups difficult. An extensive, invasive osteolytic process in bone associated with lymphomatoid disease elsewhere in the body should immediately suggest lymphosarcoma. Less destructive changes with combined osteolysis and osteosclerosis would be more in favor of Hodgkin's disease.

REACTION TO ROENTGEN THERAPY

On reviewing the results of radiation therapy of osseous lesions, it was found that prompt relief of pain was obtained even in cases where bone changes were unusually extensive. In 23 cases of Hodgkin's disease in which follow-up roentgenograms were made after therapy, 6 showed no reparative change in the bone; in 7 cases the reparative change continued to complete or almost complete restoration of normal bone structure; in the remaining 10 cases, the response was slight to moderate. The bone lesions in which osteolytic changes were most predominant appeared to respond best to radiation therapy. The lesions in the flat bones (sternum, wings of the ilia) and ribs responded most satisfactorily.

Two-hundred-kilovolt roentgen therapy was administered in most of these cases. The dosage was moderate in amount and was rarely over 2,000 r (in air) distributed over a period of several months. Treatment was usually given in several courses, depending upon clinical and roentgenographic response. It is difficult to estimate accurately the efficacy of the therapy, since the tissue dose cannot readily be obtained. In addition to this, radiation directed to overlying areas of soft tissue disease was administered to the bones as well. The indications for therapy are based upon alleviation of symptoms and improvement of function rather than complete restoration of bone. Of 6 patients with Hodgkin's disease in whom neurological symptoms occurred in association with vertebral disease, all except one had partial to complete restoration of neurological function.

In lymphosarcoma radiation therapy likewise was usually efficacious in relieving pain, but follow-up roentgenograms to determine the effect of therapy on bone restoration were infrequent, due largely to the fact that bone lesions usually occur in the terminal phases of the disease. In one case, complete restoration of bone was effected by roentgen therapy to a lesion in the skull. In this patient, however, disease in the femur developed six years later. In two cases, central nervous system involvement was present in conjunction with the bone lesion, and in one of these relief of symptoms was complete following therapy. In the other patient there was no improvement in neurological function.

SUMMARY AND CONCLUSIONS

Bone involvement by Hodgkin's disease and lymphosarcoma is not uncommon and represents an important complication of these two diseases. The lesions are most frequently found in the pelvis, vertebrae, ribs, and femora, and in most cases involve more than one bone.

Localized pain and tenderness were the most frequent clinical indications of bone lesions, but tumors about the bone margins and neurological changes due to extension into the spinal canal from vertebral lesions were also observed. Elevated serum phosphatase appears to be a promising index of bone extension from both lymphosarcoma and Hodgkin's disease. The serum phosphatase was most commonly elevated in lesions with evidence of osteoplastic change.

On roentgenographic studies, lesions were demonstrated in 14.8 per cent of 257 patients with Hodgkin's disease and 7 per cent of 213 cases of lymphosarcoma. Because of certain inadequacies of examination (insufficient x-ray studies and difficulty in demonstrating lesions which have not progressed to cortical destruction), these figures do not reflect the true incidence, probably being too low. The lesions were predominantly of the mixed type in Hodgkin's disease, 57 per cent showing a combination of osteoplastic and osteolytic changes. In lymphosarcoma, however, 85 per cent were entirely osteolytic. The lesions in Hodgkin's disease were more numerous, involving a greater number of bones, but the lesions of lymphosarcoma were more invasive and more widely scattered over the skeleton. The character of the bone lesions, together with features of the clinical course, is distinctive in each of these diseases, yet may not be considered sufficiently clear-cut for sharp differentiation.

In Hodgkin's disease the age distribution of patients with bone lesions differed in no important respects from that of the general group. In lymphosarcoma, however, the average age of patients with destructive lesions of bone was considerably below that of the general group. In lymphosarcoma, no difference in survival rates was observed between patients with and those without bone lesions, whereas in Hodgkin's disease, those who were found to have bone changes appeared to have a longer average survival. The difference is most pronounced during the first several years.

Bone lesions in Hodgkin's disease and lymphosarcoma occurred at any point

during the course of the disease. In lymphosarcoma, bone lesions were found to develop in 63 per cent of the patients in the final one-third of the disease span. In contradistinction to this, in only 31 per cent of the patients with Hodgkin's disease did bone lesions appear during this portion of the course. This is of prognostic significance and would indicate that development of bone lesions in lymphosarcoma is often a terminal event.

Radiation therapy offers definite amelioration of symptoms in the osseous lesions of Hodgkin's disease and, in some cases, completely restores the invaded bone to its normal structure. The doses given were moderate, administered primarily for relief of symptoms rather than for restoration of bone. Similar clinical improvement occurred in lymphosarcoma after radiation therapy, but no opportunity to follow the bone changes was available because of the short average survival after skeletal invasion.

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DISCUSSION

Ralph S. Bromer, M.D. (Bryn Mawr, Penna.): It is the roentgen diagnosis of the bone lesions of Hodgkin's disease and lymphosarcoma which interests me especially. Dr. Friedell has pointed out

that the lesions in Hodgkin's disease are more numerous, involving a greater number of bones, while the lesions of lymphosarcoma are more invasive and more widely scattered over the skeleton. Another important point is the fact that 58 per cent of the cases of Hodgkin's disease showed a combination of osteolytic and osteoplastic changes while in lymphosarcoma 85 per cent of the lesions were entirely osteolytic. There are no points or signs by which these two conditions can be distinguished from other destructive changes in bone causing osteolytic changes. Thus I have recently seen a lesion in the ilium, due to Hodgkin's disease, which had a cystic appearance.

In the literature of Hodgkin's disease there appear some interesting cases from the standpoint of diagnosis. Blount (J. Bone & Joint Surg. **11:** 761–770, October 1929), some years ago, reported a case in which the bone involvement preceded enlargement of the lymph nodes by two years and led to a mistaken diagnosis. In his patient the lesion in the spine resembled tuberculosis and in his conclusions he emphasizes this point. He concluded, also, that skeletal involvement in Hodgkin's is much more common than has been realized, and, still more important, that it may be primary.

Lockwood (Radiology **14:** 445–452, May 1930) reported a case of Hodgkin's disease in which the lesions were situated in the first to the fourth lumbar vertebrae and the ilium and the femurs. His patient, preceding the discovery of the bone lesions, had an attack of shingles, and he states that the occurrence of shingles as a premonitory warning of the existence of Hodgkin's disease has been overlooked in the literature. In a conversation with Dr. Lockwood, a few minutes ago, he told me that since the publication of that case he has had two similar cases. I think this point in diagnosis should be taken into consideration.

I have several slides of a case of reticulum-cell sarcoma of bone in which osteolytic lesions were found resembling those of lymphosarcoma.[1] Parker and Jackson (Surg., Gynec. & Obst. **68:** 45–53, January 1939) state that reticulum-cell sarcoma has been variously diagnosed as Ewing's tumor, Hodgkin's disease, lymphosarcoma, and osteogenic sarcoma. Pathologically, it can be differentiated from lymphosarcoma by the type of cell, with its large round nucleus, scanty cytoplasm, and spherical shape. Parker and Jackson also state that the granulomatous form of Hodgkin's disease, with sclerosis, necrosis, eosinophils, and Reed-Sternberg cells; should present no difficulty in differentiation from this condition. The sarcomatous form, in which the majority of the cells are of the mononuclear type, may simulate closely anaplastic reticulum-cell sarcoma, but the presence of even an occasional typical Reed-Sternberg cell should serve as a differential point. This condition, although rare, must be borne in mind in the differential diagnosis of Hodgkin's disease and lymphosarcoma.

[1] Slides were shown at this point.

Problems in Roentgen Therapy for Hodgkin's Disease and Lymphosarcoma[1]

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GENERAL PROBLEMS

WHEN A RADIOLOGIST has to deal with Hodgkin's disease or lymphosarcoma, the tendency is to give the greatest attention and direct most of the treatment to the cervical, axillary, and inguinal lymph nodes. Sometimes, the mediastinal nodes may be found to be involved, and these also may be treated. But frequently enough, the patient's symptoms may continue unabated or, after diminishing to some extent for a time, may soon become as severe as they were originally. This failure to obtain maximal improvement may be due to one or more of several causes: (1) improper anatomic arrangement of the treatment with reference to the lesions responsible for the most prominent symptoms; (2) improper time distribution of the treatment; (3) the quantity of rays given to each field; (4) the quality of the rays; (5) pathologic factors; (6) clinical factors related to the stage of the malignant process. By the anatomic arrangement of the treatment, I refer to the number, size, and arrangement of the fields of irradiation, as well as to the direction of the different beams of rays with reference to the regions chiefly involved.

Cervical Lymphadenopathy: In many cases Hodgkin's disease or lymphosarcoma begins in the cervical lymph nodes and gradually extends to other groups of nodes in different parts of the body. The rapidity with which the cervical nodes enlarge and the volume which they attain vary greatly in different cases. At the beginning, and sometimes for a long period (several months or several years), the nodes enlarge for a time and then recede, and this cycle may be repeated indefinitely. Patients often think that when the nodes recede they have disappeared; usually they have not disappeared, but have diminished in size until the patient is no longer aware of their presence. As these cycles continue to recur from time to time, the general tendency of the affected nodes is to increase in size gradually. In some cases they may remain small for a long time, and then, for some obscure reason, may begin to enlarge, reaching considerable proportions in a short time. The cervical nodes may thus attain the volume of olives, of plums, or even of lemons. In other cases they never become so large, and in still others they remain small throughout the course of the malignant process. Why this should be so is not yet known. At any rate, the mere size of the nodes does not give any indication of the degree of malignancy or of the seriousness of the patient's condition.

Sometimes the tonsils may be affected, or evidence of involvement may be found in the nasopharynx or in the accessory sinuses. Under these circumstances, the tendency is to regard this as the primary site of the malignant process and the enlargement of the cervical nodes as a secondary manifestation. In some cases this represents the true sequence of events, but in other cases a careful analysis of the patient's history and of the physical observations may prove or suggest that the primary lesion was in the mediastinal or the retroperitoneal nodes, and that the disturbances in the cervical nodes as well as in the tonsils, nasopharynx, or larynx may really be secondary.

If the treatment is to yield maximal improvement, it must be so arranged as to deal most effectively with the lesions which are responsible for the symptoms. When the cervical nodes are small or moderate in size, and when the nodes in other regions

[1] Presented before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

are not affected, a single field on each side of the neck may be sufficient. When the involvement is confined to the nodes on one side of the neck, treatment should, of course, be limited to a single field on the affected side.

When the lymphadenopathy extends throughout the length of the neck, and especially when the submental, submaxillary, preauricular and postauricular, or occipital, nodes are involved, or when the patient's neck is unusually long, the region may be too large to be included in a single field on each side. In such a case, each side must be divided into two fields. When the nodes have become very large and form a massive chain from the level of the ear to that of the clavicle, the best results may require two or four fields on one or both sides. In this event the neck is divided as evenly as possible by a line extending from the lobe of the ear, or higher, down to about the middle of the clavicle; the width of the fields depends on the size of the neck and extends from this line to the median line anteriorly, and posteriorly to a line which follows the hair line downward and includes the anterior border of the trapezius muscle. The two or four beams of rays are directed so as to converge on the enlarged nodes from either side of the central dividing line.

When, as not infrequently happens, the nasopharynx, pharynx, or tonsils are primarily or secondarily involved, the treatment must take into consideration not only the affected structures on one or both sides, but also the extent of involvement and the thickness of the neck and face. Effective treatment may be possible through a single field on one side, or it may be necessary to arrange the treatment through two lateral fields on one or on each side. Sometimes the malignant process may have extended to one of the antrums or to the other accessory sinuses. In this event, one or two additional anterior fields may have to be provided. Of course, extensive involvement such as this usually occurs only when the pathologic process has reached a rather advanced stage. Substantial improvement may result even then, but the improvement is not likely to last as long as it does when the condition is less advanced.

Mediastinal Lymphadenopathy: When the principal symptoms are referable to the respiratory tract and include cough, dyspnea, orthopnea, sometimes dysphagia and a rapid pulse rate, when the physical signs are in harmony with the symptoms, and when the roentgenographic findings include enlargement of the mediastinal structures, with or without evidence of fluid in one or both pleural cavities, the treatment should first be directed to the intrathoracic structures so as to give the patient relief as quickly as possible. How much improvement may be brought about and how quickly the symptoms may be relieved depend on how advanced in its course and how extensive the malignant process is, and on the arrangement of the treatment. If the condition has not advanced too far, and if the treatment is well arranged, the rapidity of improvement is often astonishing. Under these conditions treatment is sometimes given either through a single anterior field or through one anterior and one posterior field; usually this is followed by only slight improvement, which does not last long. When two anterior fields and two corresponding posterior fields are irradiated, the effect is much greater, provided the fields are large and well placed, provided the four beams of rays are so directed as to converge on the mediastinal structures with reasonable accuracy, and provided a sufficient dose of rays is given within a reasonably short time.

As a rule, the upper level of the four fields should correspond to the level of the suprasternal notch, and the lower level should correspond to that of the ensiform cartilage. Laterally or transversely, the fields should extend from the median to the anterior or posterior axillary line, as the case may be.

When Hodgkin's disease or lymphosarcoma involves the mediastinal nodes, a roentgenogram of the thorax usually reveals a bilateral widening of the mediastinal structures, which extends from the inlet of

the thorax downward to the cardiac shadow, which it usually overlaps, more or less. But exceptions are not uncommon. Sometimes, the nodes mainly affected are on one side or the other of the mediastinum, and the roentgenologic appearance may make it difficult to be certain whether the lesion is lymphoblastomatous or carcinomatous, or perhaps a dermoid tumor. Sometimes, the mediastinal enlargement may be bilateral and ovoid in shape, and again the distinction between lymphoblastoma and carcinoma or dermoid tumor cannot be made with certainty from the roentgenologic appearances alone. In some cases the lymphoblastomatous character of the lesion can be recognized by other clinical features, such as enlargement of nodes in the neck or armpits, with or without involvement of the retroperitoneal and inguinal nodes. In other cases, however, such associated features may not be present. Then it is that irradiation of the mediastinum may, by causing a characteristically rapid regression, not only relieve the patient's symptoms but give a reliable clue to the pathologic character of the tumor.

Occasionally, the principal involvement is high in the mediastinum, and the symptoms may include not only dyspnea, with or without dysphagia, but also a brassy cough, hoarseness from involvement of one or both recurrent laryngeal nerves, puffiness and semicyanosis of the neck and face, and prominence of the superficial veins due to venous obstruction at or near the inlet of the thorax. The cervical nodes also may be abnormally large but, owing to the puffiness and engorgement, they may be difficult to perceive with certainty. The physician who is "thyroid-conscious" may think that the roentgenogram suggests substernal extension of the thyroid, but the prompt regression of the growth and relief of the symptoms during and after irradiation may show this also to have been essentially lymphoid in character. In cases of this kind, not only should the mediastinum be irradiated through two anterior and two posterior fields, as already indicated, but the lower half of the neck should also be treated from each side. These two beams of rays should be directed inward and downward so as to converge on the structures at and just below the inlet. In this manner the effect of irradiation is greatly increased.

In some cases of mediastinal lymphoblastoma roentgenograms of the thorax show little, if any, widening of the mediastinal shadow, and yet the symptoms suggest more or less definite involvement of the tracheobronchial nodes situated in and around the angle of the tracheal bifurcation. The reason the roentgenograms do not show lateral projection beyond the edges of the composite shadow cast by the sternum and spinal column may be that the affected lymph nodes have an anteroposterior disposition. In any event, irradiation through two anterior and two posterior fields, with the four beams of rays converging sharply on the mediastinal structures, is often as effective as in cases in which the anatomic disposition of the affected nodes is more orthodox.

In lymphoblastoma pleural effusion may be caused by partial obstruction of the inferior vena cava by enlarged nodes in the lower part of the mediastinum; because the adenopathy is concealed by the cardiac shadow, it may not be visible in roentgenograms. Or the effusion may be due to infiltration of the pleura. In such cases effective irradiation requires that the fields be large enough to include the lower two-thirds of the mediastinum as well as the entire diaphragm. Involvement of this kind, however, usually occurs only when the pathologic process has reached a relatively advanced stage, and prolonged improvement can hardly be expected under these circumstances.

Rarely, Hodgkin's disease or lymphosarcoma may infiltrate the lungs in what approximates a miliary manner. That is, the infiltration is scattered more or less throughout the lungs in the form of small, almost miliary foci. Infiltration of this kind indicates that lymphoblastoma has invaded most or all of the small aggregations of lymphoid cells situated at the junc-

tion of the smaller branches of the bronchi. This form of infiltration also is a relatively late complication. Nevertheless, thorough irradiation may result in pronounced improvement. Duration of improvement varies with the circumstances in each case.

Sometimes, when lymphoblastoma affects the mediastinal nodes, the patient complains of pain in the chest, which may extend to one or both upper extremities. Occasionally, the pain may be confined to the extremities, and there may be no chest pain. Roentgenograms may show obvious or even marked involvement of the nodes, but in some instances evidence of mediastinal involvement may be slight or actually uncertain. Under these circumstances, it is important to exclude, by careful examination, the possibility that the pain may be due to pressure irritation or actual infiltration of branches of the brachial plexus on one or both sides by lymphoblastoma affecting some of the cervical nodes or nodes in the upper part of the axillary (infraclavicular) space. If this possibility can be excluded, then the treatment should be directed to the mediastinum, as already suggested.

Axillary Lymphadenopathy: The axillary nodes are seldom the first to be affected in Hodgkin's disease or lymphosarcoma, but occasionally a case is encountered in which primary involvement of these nodes appears to have occurred. In most instances, however, when the axillary nodes are found to be abnormally large, a carefully taken history and a painstaking examination will show that the cervical, mediastinal, or other nodes had been affected for some time before. When only a few nodes can be felt, and when these are small or of medium size, little attention need be given to them beyond periodic examination, because they practically never cause any symptoms.

When the axillary nodes are numerous and large, and especially when they fill the entire axillary space as high as the clavicle, it is often found that they form an extension of a similar mass of enlarged nodes above the clavicle or throughout the neck. The clavicle may be almost buried in this continuous and massive chain of nodes which extends beneath it. In other cases it may be impossible to feel individual nodes, and the entire infraclaviculo-axillary space may be filled by what appears to be a single solid mass. Under these circumstances, branches of the corresponding brachial plexus may be affected more or less, and sensory or motor disturbances around the shoulder or in the upper extremity may result. Or the nodes may be so large and so closely packed as to interfere with the return of venous blood from the upper extremity, and edema may develop.

When the axilla contains only a small number of nodes, with an average diameter of 3 cm. or less, a single beam of rays directed upward and inward through a single field may be sufficient. But when the entire infraclaviculo-axillary space is filled with large nodes, two, three, or even as many as five beams of rays may have to be concentrated on this region, through as many fields, if the maximal effect is to be obtained.

Occasionally, focal or rather diffuse osteoporosis of the clavicle, and sometimes of the humerus also, may be observed. This probably does not depend on the degree of involvement of adjacent supraclavicular, infraclavicular, or axillary lymph nodes because, in the few patients whom I have seen, the cervical and axillary nodes were very small. Roentgen therapy does not appear to influence the osteoporosis.

Abdominal Lymph Nodes: From the standpoint of involvement by lymphoblastoma, the main groups of abdominal nodes are those along the aorta, inferior vena cava, and iliac vessels, and those in the root of the mesentery. This does not mean that Hodgkin's disease or lymphosarcoma invariably starts in one or the other of these two groups of nodes. Actually, these conditions may begin in any lymph nodes or agglomeration of lymphoid tissue in the body, such as a node under the serosa of the gastric wall, a Peyer patch or lymph follicle in the small intestine, or in the lymphoid tissue of the vermiform ap-

pendix. But, from a practical standpoint, these conditions start most frequently in the para-aortic nodes. Because the nodes which constitute this group drain the lymph from all the large and important organs in the abdomen, they are the most important group of lymph nodes in the body. Anatomically considered, they are extraperitoneal or, as they are usually called, "retroperitoneal."

Lymphoblastoma probably begins in the retroperitoneal nodes more frequently than is generally supposed. Further study will be required to prove or disprove this point. Even when these forms of malignant growth begin in the cervical or axillary nodes, they often extend sooner or later to the retroperitoneal nodes.

When the para-aortic or mesenteric nodes become affected by lymphoblastoma, the symptoms may at first and for some time be so slight and vague that their recognition is difficult. Moreover, they may vary considerably in different cases. These symptoms may consist in a tendency to bloat and belch after eating, distress in the upper half of the abdomen after meals, and loss of strength, which patients usually express as tiring easily, loss of endurance, or loss of "pep." As months or years elapse, these symptoms tend gradually to increase, and others develop. The latter may include a sense of heaviness or of weight in the epigastrium, especially after eating, increasing difficulty to eat a full meal, pain in the epigastrium, which may recur after each meal, an increasing tendency toward constipation, pain in the lower thoracic, lumbar or sacral portions of the back, often extending to one or both hips, and down one or both lower extremities, fever occurring in periodic bouts at varying intervals or continuing steadily, although with variations in intensity, regional and later general itching, with or without cutaneous lesions, which may be mistaken for urticaria, impetigo, scabies, and so on. I shall not discuss these symptoms further except to mention that they may occur in different combinations and that some of them represent absolute signs that the retroperitoneal nodes have become involved.

When a patient is known to have Hodgkin's disease or lymphosarcoma, fever or itching, or both, mean that the condition has invaded the retroperitoneal nodes. A combination of two or more of the other symptoms mentioned may mean the same thing, but the evidence is not so conclusive. Proof of the foregoing is to be found in the fact that, if the retro-abdominal nodes are properly treated, the fever, itching, and cutaneous disturbances, if present, diminish or disappear soon after treatment, unless the pathologic process has reached an advanced stage or has entered the terminal phase. With few exceptions, and then never to the same degree, this effect is not observed when the treatment is directed toward regions other than the abdomen.

The variation in abdominal symptoms in different cases probably depends on the particular nodes or group of nodes which are most involved and on the anatomic relationships of these nodes to various abdominal organs or structures. Sometimes lymphoblastoma may affect chiefly the upper para-aortic nodes. These are situated in the region of the celiac axis and are thus immediately behind the stomach, pancreas, and duodenum, and in close proximity to the mouth of the thoracic duct. It is not surprising, therefore, that when some of these nodes become abnormally large they may give rise to pressure disturbances of any of the structures mentioned. They may crowd the liver and spleen forward and downward. When these nodes enlarge in an upward direction, they may press on the diaphragm and cause dyspnea, or they may interfere to some extent with the action of the heart. Sometimes enlargement is mainly in a posterior direction, causing pressure erosion of some of the lower thoracic vertebrae, or the pathologic process may infiltrate the intervertebral spaces, may thus extend into the spinal canal, and even invade the cord.

In other cases the para-aortic nodes mainly affected are below this level, and the pressure disturbances then are most likely

to concern branches of the lumbosacral plexus, the colon, and the lumbar vertebrae. Sometimes the nodes principally involved are lower still; they may be situated around the bifurcation of the great abdominal vessels or along the common iliac vessels. Rarely, the iliac nodes may become large enough to cause pressure erosion of the wing of the ilium. Rarely, also, the nodes mainly affected may be those along the internal iliac vessels; the symptoms may then be referable chiefly to some of the pelvic structures, as the ureters, bladder, or rectum.

As involvement of the retroperitoneal nodes by lymphoblastoma progresses, not only the para-aortic nodes, but the mesenteric nodes also may be invaded. Sometimes, in fact, the involvement finally becomes so extensive that practically every structure containing lymphoid tissue is infiltrated more or less. This, of course, is most likely to occur in the late stages.

In order to treat most effectively lymphoblastoma affecting the retroperitoneal nodes, it is important to recognize these different possibilities or probabilities and to arrange the treatment accordingly. When the nodes chiefly affected are those along the abdominal aorta, between the bifurcation and the diaphragm, two large anterior fields, extending from the junction of the ensiform cartilage to the sternum down to just below the level of the umbilicus, and two corresponding posterior fields, are sufficient. But when the involvement includes the iliac and inguinal nodes, four anterior and four posterior fields are required. When, as occasionally happens, the iliac and inguinal nodes are chiefly involved, the treatment is best given through two low anterior and two corresponding posterior fields; the anterior fields in this case should extend well below the inguinal fold, so as to include the nodes in Scarpa's triangle.

Certain exceptions, however, should be considered. When retroperitoneal involvement is minimal or uncertain, or when the general condition is such that ability to tolerate more thorough irradiation seems doubtful, it may be advisable to give only limited treatment so as to bring about improvement without taxing the patient's tolerance. Later, after the general condition has improved, more thorough treatment can be undertaken. In these cases the first course of treatment may be given through two or four posterior fields only. When the patient is thin or when the contour of the trunk is relatively flat from front to back, the same distribution of fields may be adopted with advantage.

In women aged less than forty years, when evidence of pronounced involvement of the iliac nodes cannot be found, neither the anterior nor the posterior fields should extend below the level of the crest of the ilium. Otherwise, artificial menopause may be induced, and this only adds to the patient's difficulties.

Irradiation of the abdomen tends to influence the leukocytes even more than irradiation of other parts of the body. Hence, when this region is treated the leukocytes should be watched more closely than ever. With us, daily blood counts are the rule. As the treatment proceeds, the number of these cells tends to decrease; often this decrease is not steady and considerable fluctuation may be observed from day to day. Sometimes, on account of leukopenia, the treatment may have to be discontinued for one or two days, or abandoned altogether. The leukocytes may remain at an abnormally low level for periods which may vary from two or three weeks to two or more months, and this may interfere with subsequent treatment. Then the number of these cells tends to increase until they again reach the normal level. The rapidity with which leukopenia develops, its duration, and the rate of regeneration vary greatly in different cases and depend on a number of factors, such as the stage of the malignant process, the volume of body tissue subjected to treatment, the regions treated, and the dose of rays given to each field, as well as the total dose. Besides these factors, individual variation plays an important part. Occasionally a patient is

encountered in whom leukocytic regeneration is extremely slow or in whom leukopenia may continue indefinitely.

Quality of Roentgen Rays: Because the consensus now is that difference in wavelength *per se* does not influence the effect of the rays, it is generally assumed that all tumors, and even inflammatory lesions, may be treated with rays of the same quality, generated usually at or about 200 kv. Here and there, some radiologists even use rays generated at voltages of between 400 kv. and 1,000 kv. Rays generated at 200 kv. or more have the advantage of delivering a greater dose at a depth of, say, 10 cm.; they induce less severe cutaneous reactions, and, at the higher voltages, they tend to induce less radiation sickness. These advantages may be of considerable importance in treating relatively resistant tumors, such as epithelial tumors of the uterus, bladder, prostate gland, or rectum, but in treating Hodgkin's disease, these apparent advantages may lead us to overlook other factors which may be even more important.

The lymphoid cells, which are such important features of lymphoblastomatous tumors, are much more sensitive to roentgen rays than is generally realized. Therefore, as will be brought out later, effective treatment does not require the maximal dose of rays in a given time that is required for tumors made up chiefly of epithelial cells. When the enlarged nodes are relatively superficial, as in the neck, armpits, or groins, the level of absorption also becomes important. The greater the proportion of a beam of rays which penetrates the body to a depth of 10 cm., the smaller is the proportion of this beam absorbed by the first 3 cm., and *vice versa*. When the treatment is directed against enlarged nodes in the neck, armpits, or groins, therefore, rays generated at a voltage of 130 or 140 kv. are more effective because a greater proportion of the rays are absorbed by the affected nodes. Even when the nodes are very large, rays generated at this voltage are often, although not always, more effective than rays generated at 200 kv. or more. When, owing to massive enlargement of the nodes, it becomes important to produce the greatest effect in a short time, this can usually be done more effectively by increasing the number of fields, and therefore of beams of rays, than by increasing the voltage.

When the problem is to treat enlarged nodes in the mediastinum or abdomen, the tendency again is to employ rays generated at 200 kv. or more. In some cases, especially when the patient is a person of unusual size or exceptionally obese, the more penetrating rays may produce the most favorable result, but in the average case rays generated at a medium voltage (130 or 140 kv.) will be found as effective, and often more effective, provided the number, size, and position of the fields are carefully planned, and provided the beams of rays are well directed.

After having treated more than 2,000 patients suffering from lymphoblastoma, and having tried rays generated at three ranges of voltage, but especially at 140 kv. and 200 kv., I am firmly convinced that, even for mediastinal and retroperitoneal lymphoblastoma, 140-kv. radiation is more effective in the majority of cases immediately and in the long run, provided the treatment is well planned from an anatomic point of view and provided excessive quantitative doses are avoided.

Quantity of Roentgen Rays: Fashion or vogue appears to play as important a part in radiology as it does in most other forms of human activity. Because in epithelial and other tumors effective destruction of the malignant cells requires the largest dose of rays which can be given with safety, it is widely assumed that the same is true of all malignant processes. When lymphoblastoma is limited to a single region, and especially when it is confined to a small cluster of nodes, the hope of effecting a permanent cure may reasonably be entertained, and a complete result can sometimes be achieved. Even then, however, doses of the order of those required for epithelioma are not necessary. The lymphoid cells in the affected lymph nodes are

usually so sensitive to the rays that much smaller total doses are sufficient.

Occasionally, when the pathologic process appears to be confined to a single group of nodes, the attempt to effect a permanent cure by concentrating the maximal dose of rays on the affected nodes may be justified. In the great majority of cases, when the patient consults a physician, the malignant lymphoid process has already invaded two or more groups of nodes in different regions. Not infrequently, the process has already reached an advanced stage in its course, and sometimes it is already near or actually in the terminal phase. Under these circumstances, a cure is impossible, and the most that can be expected is a variable degree of improvement for a variable period of time. When lymphoblastoma is not too advanced, and especially when it is of a relatively chronic form, the patient's condition is susceptible of great improvement, and he may survive from five to twenty years, or even longer. In all these cases the aim of the radiologist should be to obtain maximal improvement and to maintain this improvement as long as possible. This can seldom be achieved by the method of maximal total doses made possible by protracted fractional irradiation. To follow this course may yield excellent initial results, and it may be repeated once or twice at the most. But when the pathologic process again becomes active, further treatment is impossible or, if it is undertaken, it has little if any effect, and the patient no longer obtains relief. A more effective method, in my estimation, is to give to each field, in one or two days, as large a dose as can be given without taxing the tolerance of the skin and other tissues or of the patient as a whole. As a rule, such a dose is between 550 and 600 roentgens (surface dose, measured in air). The different fields are thus treated successively, one at a time, until all the fields have received the specified dose. The number of days required to complete the course of treatment depends on the extent of involvement and the number of fields to be irradiated, as well as on the tolerance of the patient. When a single cervical field requires treatment, this may be given in one or two days; but when most of the lymph nodes must be treated, from ten to sixteen days may be required.

Time Distribution of Treatment: In the two preceding sections I have attempted to point out why, in Hodgkin's disease and lymphosarcoma, the maximal total doses necessary for epithelial and other resistant tumors are much less important. If maximal doses are not only unnecessary but often are less effective, then it must be evident that protracted fractional irradiation is also unessential. These considerations, of course, are based on the long-term welfare of the majority of patients. Since much of what might be written on this phase of the subject has already been covered under the two preceding headings, it need not be repeated.

From time to time, for many years, I have seen patients who have told me that they had previously been treated with roentgen rays for one month or for several months. When asked whether the treatment had caused the enlarged lymph nodes to recede and their condition to improve, they have replied that at first the nodes diminished slightly for a short time, but later the treatment remained without perceptible effect. Upon inquiring into the chronologic arrangement of the treatment, I was told that treatments had been given only once or twice a week. Yet, when these patients were treated according to the general scheme which I have described, the nodes regressed, and the general condition improved as rapidly and as much as if they had never been treated at all. Later, when the pathologic process again became active, additional treatment has again, and repeatedly, produced satisfactory improvement. There seems to be no doubt that the reason the previous treatment had yielded only slight and transient benefit in these patients was largely that the interval between sessions had been too long or that the quantity of rays given at each session had been too small. My own conclusion is that frequently both factors are respon-

sible. Treatment once a week or even twice a week cannot possibly produce the improvement to which the patient is entitled.

Sometimes, the slight initial improvement and subsequent failure to improve are attributed to an increased resistance of the affected lymph nodes, but when these same nodes and these same patients improve satisfactorily under a different scheme of treatment, the assumption of increased resistance obviously does not rest on a sound basis. This problem of increasing resistance of cells has interested me for many years. As far as the lymphoid cells are concerned, the principal factor in increasing resistance to irradiation appears to be excessive quantitative doses. If these are avoided, and if clinical factors in each case do not account for increased resistance, the affected nodes and structures continue to respond for a long time. It is true that as time goes on, especially in the chronic form of lymphoblastoma, some increase in resistance gradually develops, but this is slow. In my experience, the main causes for failure of lymphoblastomatous lesions to respond are: (1) an advanced stage or terminal phase of the pathologic process; (2) excessive quantitative doses of rays within a given time.

Pathologic Factors: Occasionally a patient is encountered in whom the lymphoblastomatous tumors do not retrogress at the rate or to the degree expected. Frequently, this is because the pathologic process has reached an advanced stage or has entered the terminal phase. When failure of the enlarged nodes to retrogress as usual is not due to this factor, it can almost always be traced to one of the following causes: (1) the presence in the mass or masses of enlarged nodes of an exceptional proportion of connective tissue; (2) the presence of old calcified deposits in some of the nodes; (3) the presence of secondary infection. The first two factors seem to occur chiefly in mediastinal tumors, whereas the third factor seems to occur chiefly in the cervical nodes. All three, however, are uncommon.

Clinical Factors Which Influence the Effect of Treatment: Besides the extent of involvement, two other factors have an important bearing on the results which may be expected from treatment. One is the relative acuteness or chronicity of the malignant process in each case. In some cases lymphoblastoma runs a comparatively short course, and the time which elapses between the apparent onset of the disease and the death of the patient may vary between six months and two or three years. In other cases the course of the process may extend from three to five or six years; these constitute the intermediate group. In still other cases the condition may persist from five to twenty years, or longer. In cases of relatively acute lymphoblastoma, roentgen treatment may be followed by exceptionally rapid regression, but this is of short duration. In the chronic cases, proper treatment is often followed by marked regression and prolonged improvement. These are the cases in which long remissions are obtained.

The other clinical factor is the stage of the malignant process. Sooner or later, in practically every case, the condition reaches an advanced stage in its evolution and finally enters the terminal phase. When this occurs, the enlarged lymph nodes or other diseased structures respond to treatment less and less. Usually, this failure of response is associated with other signs of advanced disease, but perhaps the best single indicator is the numerical status of the red blood corpuscles. As long as they remain at or near the normal level, the patient may be expected to derive improvement from treatment; but when their number begins to diminish more or less steadily, this is usually the beginning of the end. Death may not occur for six months or may be delayed for three years, but a more or less steady decrease in the number of erythrocytes usually means that the end is rapidly approaching.

SPECIAL PROBLEMS

Infiltration of the Skin: Occasionally, Hodgkin's disease or lymphosarcoma ex-

tends outside the lymph nodes and infiltrates various other structures. Thus, the skin may sometimes be infiltrated more or less widely. When this occurs, the skin tends to thicken irregularly, and this thickening may be attended by more or less severe itching, sometimes complicated by the appearance of papules or nodules which project above the surface; these may simulate the lesions of impetigo or they may closely resemble the lesions of erythema nodosum; or they may be of a dull, beef-red color. When nodules are present, they gradually increase in size and number and may appear anywhere. For a time this complication usually responds well to treatment, but since it usually occurs late in the course of the process, it can seldom be controlled for a long time.

Rarely, the infiltration affects only the deep layers of the skin without any change in its external appearance. This can be recognized only by a deep and diffuse thickening which makes the skin feel almost like soft cardboard. This variety of infiltration may affect at first only one part of the body, such as an extremity, but may later extend to the corresponding part on the opposite side, without involving the intervening skin. It is remarkable how well this yields to treatment; but it tends to recur from time to time and the treatment must be repeated. Gradually, the treatment becomes less effective.

Infiltration of Subcutaneous Tissues: Sometimes, late in the course of the pathologic process, lymphoblastoma may infiltrate diffusely the subcutaneous tissues of an entire region, such as the breast, one side of the thorax, or the neck. This form of involvement also subsides promptly after treatment but, since it is a late complication, the ability to bring it under control does not affect the main issue.

Another uncommon and rather late manifestation of lymphoblastoma is the formation of nodules in the scalp. These tend to grow slowly and, if allowed to go untreated, they may attain some size, and the visible, outer parts of some of the nodules may in time assume a dull, beef-red color. These nodules usually subside and disappear promptly after treatment. When the nodules are numerous and widely scattered, the entire scalp may have to be irradiated uniformly.

Infiltration of Abdominal Organs: Lymphoblastoma may sometimes extend from the retroperitoneal nodes and infiltrate the pancreas, the stomach, or the intestine. It is possible, however, for the stomach or intestine to be affected primarily, and in some cases it may be very difficult to determine where the primary lesion was. Not infrequently, involvement of this kind is mistaken for carcinoma but, unlike carcinoma, more or less rapid, and sometimes unexpectedly great, regression and improvement may follow thorough irradiation, when the lymphoblastomatous process is not too advanced in its course. The improvement in the condition of the patient may continue for several months or for two or three years, but sooner or later the pathologic process again becomes active and increases until the patient dies. In treating cases of this kind, the total dose which may be concentrated on the affected structures depends on the general condition of the patient, on the extent of involvement, and on the condition of the blood. Usually, the treatment is best given through two large anterior fields and two corresponding posterior fields. Sometimes three fields may be sufficient, but when the involvement is extensive, the number of fields may have to be increased accordingly.

Infiltration of Rectum: Rarely, lymphoblastoma may affect the rectum more or less extensively. Usually, this also occurs rather late in the course of the malignant process. Thorough roentgenologic treatment may again result in striking improvement for a variable period. Later, however, the disease takes the upper hand, other complications appear, and the patient succumbs.

Infiltration of the Orbit: An unusual complication of lymphoblastoma is infiltration of the orbit of one eye or both eyes. Sometimes the infiltration extends to the lids, and rarely the eyeball itself may be af-

fected. Common symptoms are diplopia, proptosis of the lid, and exophthalmos. These may be the presenting symptoms, and the patient may not be aware of any other disturbance. When the entire orbit and its contents are exposed to a dose of 500 roentgens of rays generated at 140 kv. and filtered through 6 mm. of aluminum, the rapidity with which the infiltration diminishes is often remarkable. In some cases a single exposure is sufficient, but in other cases a second exposure may be required to obtain complete regression of the infiltrate.

Infiltration or Erosion of a Bronchus: Another exceptional complication is the infiltration or erosion of a bronchus by adjacent mediastinal nodes affected by Hodgkin's disease or lymphosarcoma. For a time cough may be accompanied by the expectoration of blood-tinged sputum. If this complication is recognized or suspected, proper treatment directed to the mediastinal nodes may promptly relieve the situation, but if it is not suspected and treatment is not given in time, fatal termination may occur at any moment.

Infiltration of the Meninges: Occasionally, a patient who is known to have Hodgkin's disease or lymphoblastoma, who may have been treated repeatedly for two or more years, may complain that his memory has become impaired, that his mental function has deteriorated, and that speech has become increasingly difficult. When he is spoken to, his response may be delayed, and his speech may be scanning and abnormally slow. Roentgenologic treatment directed to the entire cranium through four or five fields, with a surface dose of 600 roentgens to each field, is usually followed by rapid improvement, and the mental difficulties may disappear within a week or ten days. Whether this complication is caused by lymphoblastomatous infiltration of the meninges or of other parts of the cerebrum is not absolutely certain, but the analogy of tuberculous meningitis suggests that meningeal infiltration may account for the symptoms.

Infiltration of the Ureter, Renal Pelvis, or Kidney: From time to time a patient is encountered in whom lymphoblastoma affecting the retroperitoneal (para-aortic) nodes infiltrates a ureter, the pelvis of a kidney, or even the kidney itself. This may be accompanied by the presence in the urine of albumin, casts, pus, erythrocytes, or actual blood, and the urea may be abnormally high. Cystoscopy or urography may disclose abnormally shaped calices, deformity or dilatation of the pelvis, or deviation and dilatation of the ureter caused by extrinsic pressure. This complication is rare and occurs only when lymphoblastoma has reached an advanced stage. Yet the underlying pathologic process may not have been recognized because, previously, the patient may have had few symptoms to indicate its presence. Nevertheless, well planned roentgen treatment may be accompanied and followed by rapid and great improvement for a time. Two large anterior and two corresponding posterior fields should be placed so that the kidneys, ureters, and the retroperitoneal nodes between them will all be included. Each field should receive a surface dose of 575 or 600 roentgens. But however pronounced the improvement which may follow, it cannot be expected to continue indefinitely. Some weeks or months later, fresh disturbances or other complications are likely to supervene, and the patient dies.

Infiltration of the Suprarenal Glands: In a few cases of Hodgkin's disease or lymphosarcoma, the skin becomes more or less deeply pigmented and, when the patient dies, the suprarenal glands are usually found more or less infiltrated by the pathologic process, which also affected adjacent retroperitoneal nodes. When all the nodes in this general territory are thoroughly irradiated, the increased pigmentation of the skin tends to diminish, and sometimes its normal color may be restored. However, this also is a relatively late manifestation and improvement cannot be expected to last more than a few months or, at most, two or three years.

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Endothelioma of the Pleura: Clinical and Roentgenologic Study of Three Cases[1]

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PRIMARY endothelioma of the pleura is usually regarded as a rare tumor. This belief is undoubtedly due, in part, to the lack of a clear-cut clinical syndrome and characteristic roentgen picture. Many patients are studied for considerable periods before the true pathological condition is recognized. The long-standing symptomatology may suggest a chronic inflammatory process and mislead the clinician as to the malignant character of the lesion. Metastasis is in most cases of late occurrence, although the primary growth is frequently multiple and widely distributed over the pleural surfaces.

Some difference of opinion exists regarding the true nature of these pleural tumors. Writers of one group believe that they are always secondary to primary carcinoma of the lung or bronchus, while others hold that they develop from the endothelial cells of the lymph spaces or lining cells of the pleural surface.

CLINICAL FINDINGS

The clinical picture in pleural endothelioma is usually inconclusive. In the earliest stage, when involvement of the pleura is slight, there may be few symptoms or none at all. Some patients complain of severe pleural pain and elevation of temperature. Stivelman (3) states that pain, as a rule, is intense and, unlike the pain of tuberculous pleurisy, is rarely relieved by development of an effusion. He also calls attention to a dry irritating cough. Banyai and Grill (1) believe that patients with early symptomless lung tumors may experience their first symptoms following influenza or some other infection, as a result of increasing bronchial stenosis. Dyspnea on exertion is common. When fluid develops, it simulates an inflammatory effusion, but malignant cells may sometimes be demonstrated microscopically in the aspirated fluid.

Anemia is sometimes present but is of little aid in diagnosis. Fever of varying degree and regularity may occur and is probably of toxic origin.

Wessler and Jaches (4) state that there is a marked contrast between the inordinate size of pleural tumors, especially the endotheliomata, and the paucity of symptoms which they produce. A patient with no symptoms other than some dyspnea and possibly fever may show extensive roentgen changes over one side of the chest.

ROENTGEN FINDINGS

In the early stages of endothelioma of the pleura the roentgen examination usually discloses a diffuse clouding of the affected area suggesting a pleural reaction with or without fluid. This usually occupies the basal or axillary areas of the chest. It is not circumscribed and has no characteristic appearance.

As the lesion continues to develop, the opacity of fluid becomes evident. When the fluid is withdrawn it reaccumulates rapidly and this fact may be the first suggestion of the presence of a neoplasm. In most instances the lung film fails to disclose the tumor nodules, although occasionally one or more may be seen above the fluid level. If the diagnosis is not made at this time, the tumor may develop to the point of invading the lung and producing an almost solid mass. The heart and mediastinum may be displaced to the opposite side by the fluid and the growing tumor.

One of the most useful procedures in the

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diagnosis of these tumors is the introduction of air, immediately following withdrawal of fluid, to produce an artificial pneumothorax. In films of the chest made in the postero-anterior and lateral projections as soon as possible after the air has been introduced, multiple tumor nodules are often clearly outlined, in a manner which is otherwise impossible. This is an old procedure and has been used for many years in chest diagnosis, but in few conditions is it of more value.

PATHOLOGICAL FINDINGS

The multiplicity of terms which have been applied to the clinical entity generally known as endothelioma of the pleura is a reflection of the diverse opinions which pathologists have held concerning the true nature of the neoplasm. The pleomorphism which is often observed in these tumors has been the chief stumbling block. As pointed out above, some claim that the lesions are metastatic from the bronchi and are carcinomata; others believe that the assumption of a mesoblastic origin, with the possibility of multipotential cell differentiation, accounts most satisfactorily for the marked variation in cellular type observed. A third group, including Ewing (2), believes that the changes produced in the pleura by the neoplastic process are specific, producing characteristic gross and microscopic changes which clearly separate the endothelioma from carcinoma.

The process first appears as multiple nodules or flat elevations on the surfaces of the pleura, extensively involving one or both serous surfaces. Subsequently the nodules fuse, the pleura becomes thickened, and the lung is ensheathed by a firm opaque layer which compresses it. The lung parenchyma may entirely escape. More often, however, the tumor invades the septa and the parenchyma, producing nodules and masses. Tumor formation is accompanied by the accumulation of serous or serosanguineous fluid in the pleural cavity. Metastasis may take place to the bronchial, axillary, cervical, and mediastinal nodes, to the liver and spleen, or even to more distant organs.

The cells are of moderate size, polyhedral or flat, with hyperchromatic nuclei and faint nucleoli. Their arrangement is almost always tubular or alveolar. They are believed to have their origin from either the subpleural lymph spaces or the lining cells of the pleura, or from both. Ewing (2) believes that two groups of serous endotheliomas should be recognized; one originates from the endothelium of the lymph spaces and shows invasive and metastatic tendencies; the other arises from the lining cells of the pleura and is superficial, nodular, and papillary. All agree that involvement begins over a wide area simultaneously.

The widespread character of the disease has suggested to some that it is a neoplastic process becoming established in predisposed subjects on the groundwork of an inflammatory hyperplasia. Others consider it strictly an inflammatory process—a form of lymphangitis and not a true tumor.

Three cases of endothelioma of the pleura have been found among the first 345,000 admissions to the Henry Ford Hospital. All were verified by postmortem examination.

CASE REPORTS

CASE 1: A white woman aged 52 years was admitted June 24, 1938, complaining of pain and tightness in the chest. About six weeks previously she had contracted a severe head cold, which lasted about three weeks. The illness persisted with fever and chilly sensations. Three weeks before admission pain developed in the right side of the chest, continuous in character but varying in location, aggravated by coughing and breathing. The cough was unproductive. During the past two weeks there had been some dyspnea and the patient could no longer lie flat. There had been a loss of ten pounds in weight. The appetite was poor. Night sweats began one week prior to admission.

Twenty years previously the patient was suspected of having tuberculosis. The condition cleared, however, and she had experienced no further trouble with the lungs until the present illness.

On physical examination, the patient appeared acutely ill. There was flatness over the entire

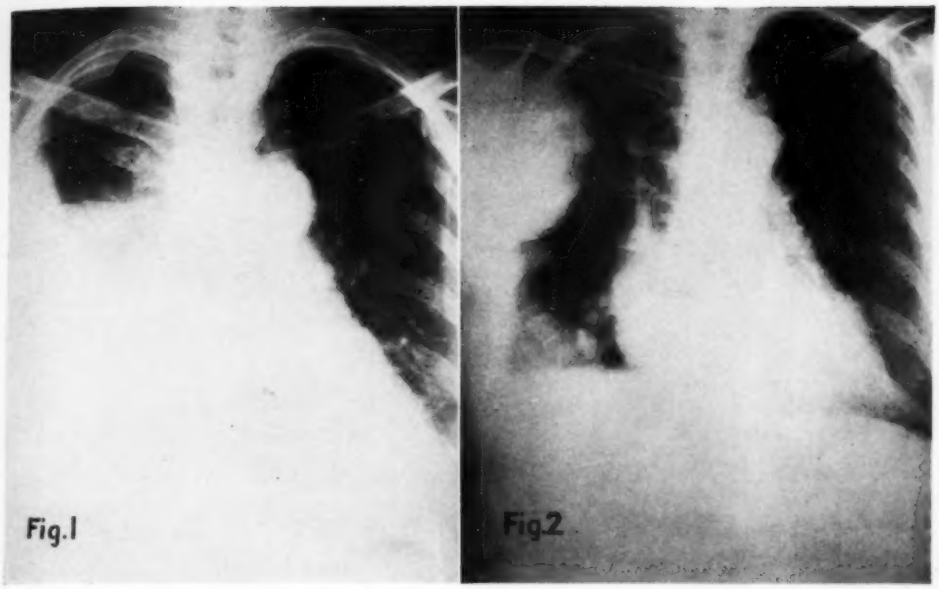

Fig. 1. Case 1: Roentgenogram (June 25, 1938), showing diffuse opacity over the lower two-thirds of the right chest, with displacement of mediastinum to left.
Fig. 2. Case 1: Roentgenogram (July 15, 1938), following aspiration of fluid and introduction of air, showing tumor along the upper axillary border of the right chest and multiple tumor nodules at the base.

right side of the chest. Breath sounds were absent and the base was immobile. The heart and mediastinum were displaced to the left side. The pulse rate was 72; blood pressure 120/80; temperature 98.8°.

The white cell count was 8,500, with a normal differential count; red cells 4,650,000. Aspiration of the chest at first yielded straw-colored fluid; later this became blood-tinged. Malignant cells were found upon microscopic examination of the fluid.

Roentgen examination, on June 25, 1938, showed a diffuse opacity over the lower two-thirds of the right chest with displacement of the mediastinum to the left, suggesting an extensive pleurisy with effusion (Fig. 1).

A second examination was made July 15, following the aspiration of 2,500 c.c. of serosanguineous fluid from the right pleural cavity and the introduction of 1,000 c.c. of air. These films show evidence of a hydropneumothorax on the right side, an oval tumor, clearly outlined, along the upper axillary border of the chest, and multiple smaller tumor nodules in the right base (Fig. 2). These changes suggested the presence of multiple pleural tumors on the right side.

Repeated thoracenteses were done, but the fluid reaccumulated rapidly and the course was progressively downward. X-ray treatment proved of no value. Death occurred Jan. 10, 1939, approximately six months after the patient was first seen.

Autopsy Findings: The right pleural space contained approximately 700 c.c. of cloudy dark green fluid. The right lung was compressed against the upper mediastinum. The visceral and parietal pleuræ showed marked thickening and were the site of numerous tumor nodules; in the base these formed a confluent mass. The left pleural space contained no tumor nodules. Neither lung was invaded.

The final anatomical diagnosis was pleural endothelioma on the right, with extension to the mediastinal lymph nodes, diaphragm, and portal lymph node. The remaining changes were not related to the endothelioma.

CASE 2: A white male aged 33 was admitted Aug. 19, 1940, with pain in the chest which had developed two weeks previously, following a summer cold. The pain was located over the lower ribs just to the right of the spine. Originally sharp and stabbing in character, it had now become dull, but had persisted and remained localized to the same area. One week before admission the patient noticed shortness of breath. Simultaneously a chronic non-productive cough appeared. Fever was present when the illness began but the temperature was now normal. Nausea and vomiting occurred two days before admission.

The past history was of no significance.

The patient was a well developed, thin, white man, evidently short of breath. The right side of

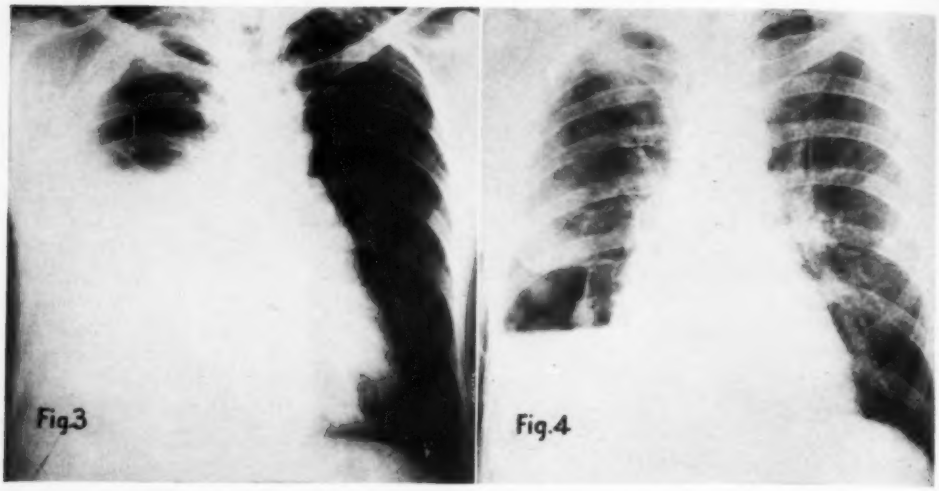

Fig. 3. Case 2: Roentgenogram (Aug. 20, 1940), showing fluid in right pleural space.
Fig. 4. Case 2: Roentgenogram (Aug. 22, 1940) following aspiration of fluid and introduction of air, showing rounded shadows suggesting multiple tumors of the pleura.

the chest was larger than the left but the respiratory excursions were limited. Vocal fremitus was absent over the right side below the level of the third rib anteriorly and posteriorly. The percussion note was flat anteriorly and posteriorly. Breath sounds were absent below the tip of the scapula and below the fourth rib anteriorly on the right side. There were coarse râles above the fourth rib anteriorly on the right side. The spoken voice came through only above the fourth rib anteriorly. The heart was 14 cm. to the left of the midline, probably due to mediastinal displacement. The pulse rate was 120 per minute; the blood pressure 96/80.

A blood count showed red cells 4,950,000; white cells 14,000; hemoglobin 13.7 gm. Urinalysis was negative.

Roentgen examination on Aug. 20 showed the cardiovascular shadow displaced to the left. There was evidence of a large collection of fluid in the right pleural space reaching upward to the level of the third rib anteriorly (Fig. 3). There was no obvious etiology for this fluid.

Progress films of the chest on Aug. 22, following withdrawal of 4,000 c.c. of serosanguineous fluid and the introduction of air into the pleural space, showed evidence of a partial pneumothorax on the right and several rounded shadows of increased density along the axillary line just above the fluid level. These were more clearly outlined by the air and suggested the presence of tumors of the pleura, probably endothelioma (Fig. 4).

Examination of fluid aspirated from the pleural cavity showed malignant cells.

The progress of the case was steadily downward. The patient was readmitted to the hospital Jan. 15, 1941, and died the same day.

Autopsy Findings: At autopsy there were 950 c.c. of blood-tinged fluid in the right pleural space. The parietal pleura on the right was quite thick and contained many nodules of tumor tissue tightly packed together. The visceral pleura also contained a few firm tumor nodules. The left chest was essentially negative except for a small amount of clear fluid. Metastases were present in the regional and axillary nodes on the right. Metastatic lesions were also found in the parenchyma of the right lung. The bronchi were uninvolved.

The final anatomical diagnosis was mesothelioma of the right pleura with metastases to regional nodes and right lung; myocardial degeneration and general anasarca.

CASE 3: An 18-year-old white girl was admitted Aug. 4, 1929, complaining of nausea and vomiting and swollen glands. In April 1929 the patient began to lose weight and felt "rundown" and nervous. In May 1929 lymph nodes in the neck, axillae, and groins became enlarged, and these had gradually increased in size.

The past history was of no significance.

The patient appeared pale and undernourished. The left mastoid was tender. The axillary nodes were enlarged. The epigastrium was tender on palpation. The blood pressure was 100/40; temperature 102.8°; pulse 130 per minute. Chest examination showed flatness over the left base, decreased vocal and tactile fremitus, harsh breath tones in the mid scapular region.

The red cell count was 3,300,000; white count 13,400; hemoglobin 11.1 gm. (70 per cent).

Roentgen examination showed the major portion of the left lung field obscured by a large amount of fluid in the left pleural cavity. The heart and trachea were displaced toward the right side. There was a small amount of fluid in the right pleural cavity with considerable pleural thickening on the right side (Fig. 5). These findings suggested the presence of an extensive pleurisy with effusion on the left side and a lesser amount on the right side.

Sections from an excised axillary node showed primary diffuse endothelioma.

The patient grew steadily worse and died Sept. 4, 1929, twenty-one days after admission.

Autopsy Findings: At autopsy there were 2,000 c.c. of fluid in the left pleural cavity. The visceral pleura on the left side was covered with a diffuse neoplasm, as was also the parietal pleura. The nodes about the hilum were moderately enlarged and bluish gray in color, showing gross metastasis. The tumor involvement was confined to the pleura and lymph nodes. The lung parenchyma was invaded only along the trabeculae extending inward. The mediastinum contained a diffuse mass resembling that in the pleural and lymph nodes. The lymph nodes here were extensively involved.

Microscopically one section of the pleura was covered with a fairly thick layer of tumor cells, which were piled up, with no alveolar arrangement. The nuclei were large and dark-staining and exhibited hyperchromatic changes and mitotic figures. Single and double nucleoli could be seen in some cells. The cytoplasm was abundant and light-staining. The stroma between the endothelial cells was loose and fibrous.

The final diagnosis was diffuse malignant endothelioma, primary in the pleura and involving the mediastinum, the visceral and parietal pleurae on the left, the peritoneal, abdominal, and retroperitoneal lymph nodes, right kidney, ureters, urinary bladder, ovaries, liver, spleen, and capsule of the adrenals.

Fig. 5. Case 3. Roentgenogram showing large amount of fluid in left pleural cavity.

COMMENT

The three cases here recorded are fairly typical. The illness, as a rule, dates from a cold or acute infection from which the patient does not return to normal well-being. Examination usually shows evidence of fluid in the pleural cavity. There may be palpable lymph nodes, but this is not common. When the fluid is removed it reaccumulates rapidly, and this cycle may recur many times unless the examiner becomes suspicious of a malignant growth. Microscopic examination of the removed fluid may reveal tumor cells, as in two of the cases reported here.

Roentgen examination showed evidence of fluid in all of our cases but did not reveal the etiological factor. In two cases air was introduced to replace the removed fluid and clearly outlined the tumor nodules. This is a useful diagnostic procedure, which should be employed more often.

The fact that autopsy in most of these cases fails to reveal evidence of any tumor in the lung itself is against the theory of a metastatic origin from bronchogenic cancer. That the tumors develop from the endothelial cells of the lymph spaces or pleural surfaces would seem to have more evidence in its favor.

The oft repeated statement that the clinician must be cancer-minded holds true in the diagnosis of these cases. These patients are often under observation for considerable periods of time before the true diagnosis is apparent. Rapid reaccumulation of fluid, in the absence of pulmonary infiltration in the apices, indicates that further study should be made of the underlying lung to rule out a lesion in this area. If the fluid is blood-tinged, the probability of tumor is heightened. Cases have been reported in which turbid infected fluid has been removed. This may lead the clinician astray. Bronchoscopy has been recommended, but it is difficult

to see how this could be very helpful, as the bronchi cannot be explored to the vicinity of the lesion.

SUMMARY

1. Three cases of pleural endothelioma have been reported, all of which were verified postmortem.

2. These cases are characterized by pleural effusion with rapid reaccumulation after removal.

3. The roentgen picture is not characteristic unless the fluid is removed and replaced by air as a contrast medium.

4. These tumors appear to originate from the endothelial cells of the lymph spaces or the lining cells of the pleura.

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Cancer of the Lung in Infancy[1]

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CANCER OF ANY type is an uncommon condition in childhood or infancy. Dargeon (6) states that only 20 cases were encountered in 10,000 children admitted to St. Luke's Hospital in New York City. Primary cancer of the lung in infancy is an exceptionally rare entity. The case reported in this communication is the only example of primary lung carcinoma in an infant in over 14,000 autopsies performed at Cleveland City Hospital in the last twenty-eight years. Lund (13), in a survey of 25,000 autopsy records of the Philadelphia General Hospital from 1867 to 1933, found no instance of primary bronchogenic carcinoma occurring before the age of twenty. Fischer (7), in the Henke-Lubarsch series, reports 4 cases in children under ten years of age and 18 in patients between eleven and twenty years of age out of a total of 1,888 primary lung cancers.

McAldowie (14), in 1876, was the first to report a primary cancer of the lung in a child, a five-and-a-half-month-old boy. At autopsy, a gross diagnosis of primary carcinoma of the lung was made. The bronchial lymph nodes were large and hard and were considered to be the only site of metastasis. McAldowie stated that he had been unable to find in the literature any report of primary cancer affecting the lungs at such an early age. His case cannot be considered truly authentic, however, since microscopic proof of carcinoma was not obtained.

Schwyter (15), in 1928, reported a case of primary adenocarcinoma involving the entire left lung in a sixteen-month-old girl. Metastases were present in the pleura, heart, diaphragm, bronchial and bifurcation lymph nodes, and soft tissues of the back, the last thought to represent inoculation metastasis from repeated lumbar spinal punctures. The roentgenogram showed a diffuse shadow, over the whole left side of the chest, the heart shadow reaching the middle of the right lung field. The entire left lung was involved in this case with the exception of the central portion, which was the seat of compression atelectasis. Schwyter also reported a primary carcinoma of the lung in a girl of five months, originating from the lining of a cyst involving the right lower lobe. This tumor was a squamous-cell carcinoma developing in a congenital lung cyst.

Beardsley (2) published in 1933 a detailed report of a case of primary adenocarcinoma of the left lung in a female infant sixteen months of age. The disease first manifested itself as a metastatic nodule, 2 cm. in diameter, in the lumbar region, when the patient was ten months old. A biopsy of this lump proved it to be adenocarcinoma. Later, recurrent carcinomatous nodes were found in this same region and were excised. Seven months following the onset of the disease, pulmonary symptoms developed. Signs of consolidation were elicited over the left chest and a firm mass measuring 2.5 cm. in diameter was present in the left supraclavicular area. A roentgenogram revealed a dense homogeneous shadow obscuring all the details in the thorax. On aspiration, 300 c.c. of sanguineous fluid were obtained from the left pleural cavity. The patient soon died from what was thought to be respiratory embarrassment. At autopsy, a large tumor was found occupying the left lung and left pleural cavity. Beneath the sternum was a protruding tumor which lay anterior to the pericardium. The heart was displaced to the right by the neo-

[1] From the Department of Roentgenology, Cleveland City Hospital and School of Medicine, Western Reserve University. Presented before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

TABLE I: CANCER OF THE LUNG IN CHILDHOOD AND EARLY ADULTHOOD

Author	Year	Age	Sex	Microscopic Diagnosis	Side
Werner (17)	1891	19	F	Carcinoma	R
Horn (10)	1907	18	F	Adenocarcinoma	L
Hirsch and Ryerson (9)	1928	5	M	Carcinoma	R
Simpson (16)	1929	13	M	Carcinoma	R
Kilduffe and Salasin (11)	1933	14	M	Carcinoma	R
Gould (8)	1934	10	M	Carcinoma, grade III	R
Cathala and Ducas (4)	1935	10	M	Malignant embryonal epithelial tumor	L
Lereboullet, Garnier and Courtial (12)	1935	5	F	Small-cell carcinoma	R
		10	M	Embryonal epithelioma	L
Cardelle *et al.* (3)	1936	11	M	Small-cell carcinoma	L
Adamson, Boyd, and Cameron (1)	1936	19	M	Anaplastic carcinoma	R

plasm, which appeared to have originated in the left lung.

The literature contains only a few case reports of primary cancer of the lung occurring in childhood, *i.e.*, beyond infancy, and in early adulthood, as shown in Table I. Even in early life there is a great preponderance of males over females. There is also an indication of a slight predilection for the right lung.

CASE REPORT

M. G., a colored infant, aged 17 months, was admitted to the pediatric service of Cleveland City Hospital July 14, 1931, because of cough and dyspnea. She had been well until five months previously, when she developed a dry cough, which was diagnosed as "whooping cough" at one of the City Baby Dispensaries. She was referred to the contagious division of City Hospital, where a diagnosis of bronchopneumonia of the left lower lobe was made. The symptoms disappeared during a five-day observation period and the patient was sent home. Later, the cough became gradually worse, but was always non-productive in character. There was no hemoptysis at any time. The weight had remained the same since the onset of the illness. The mother thought there was pain in the left chest at times. The baby had been born spontaneously, weighing six pounds. Her diet was considered to have been adequate, and on physical examination she appeared to be well nourished.

Although the child cried excessively, her illness was not considered acute. The ear drums were slightly inflamed, but presented no bulging. Purulent material was draining profusely from the left ear, probably due to otitis media with spontaneous rupture of the tympanic membrane. The pharynx appeared reddened. Examination of the heart showed the apex beat in the region of the xyphoid process. The heart sounds were heard best to the right of the sternum in the fifth intercostal space, indicating a marked degree of cardiac displacement to the right.

The right lung was hyperresonant and no râles were audible. The entire left side of the chest was dull to percussion with the exception of a small area at the apex. The breath sounds were vesicular but scarcely audible. There was no change in fremitus and no râles were heard. Palpation of the abdomen showed the liver and spleen to be enlarged about one finger's breadth below the costal margin.

Roentgen examination of the chest in the anteroposterior projection showed the entire left hemithorax to be the seat of increased density of a homogeneous character. The heart and trachea were considerably displaced to the right (Fig. 1). The roentgen findings were attributed to a large amount of fluid in the left pleural cavity.

Examination of the urine revealed no abnormal findings. The red blood cell count was 3,400,000 and the white blood cells numbered 28,000 per cubic millimeter of blood; hemoglobin, 45 per cent. The temperature on admission was 37° C. and fluctuated between this level and 38.5° during the course in the hospital. The tuberculin test with 1:1,000 dilution was negative. Vaginal, nose, and throat cultures were negative for pathogenic organisms.

The clinical impression at the time of admission was (1) left empyema, (2) suppurative otitis media, (3) acute pharyngitis.

Course: Thoracentesis of the left pleural cavity revealed clotted blood and a few small fragments of tissue. Doctor J. D. Pilcher of the pediatric service considered the condition to be a malignant tumor, probably originating from the pleura, and from the appearance of the lymphoid tissue in the sections, a tumor of the lymphoid series. Further thoracentesis was performed, with removal of 35 c.c. of hemopurulent material. The culture showed no growth of organisms after twenty-four hours' incubation. The report following a third aspiration of material from the chest was lymphoid hyperplasia with the suggestion that the possibility of a malignant tumor should be considered in the differential diagnosis.

During the three-week stay in the hospital there was a gradual retrogressive course until the child died on Aug. 7, 1931. Death was attributed to cardiac embarrassment as a result of pressure ex-

erted on the heart by the massive process in the left side of the chest.

Autopsy was performed by Doctor R. J. Williams. The left lung filled the entire left pleural cavity, displacing the mediastinal contents to the right, the apex of the heart being in the left parasternal line. No fluid was present in either pleural cavity. The left lung was adherent throughout to the parietal pleura, due to rather thin fibrous adhesions. The right lung weighed 58 grams as compared with the abnormal left lung, which weighed 475 grams. The latter appeared mottled, purplish-yellow in color, the yellow areas being very soft. The whole left lung was unusually soft and no crepitation was made out. On section, the entire left lower lobe and the lower portion of the upper lobe were found to be involved by a grayish white to gray-yellow tissue, firm in places and of "mushy" consistence in others. At the advancing margin of the lesion a number of firm gray-yellow areas, approximately 5 mm. in diameter, were seen. The bronchial lymph nodes varied from 3 to 6 mm. in diameter.

Microscopically, the tumor cells were seen infiltrating lung parenchyma (Fig. 2, A), in places entirely obliterating the lung architecture. The nuclei of the tumor cells were large, oval and vesicular (Fig. 2, B). The cytoplasm was acidophilic and indefinite in outline. There was a very slight amount of fibrous stroma. Several small areas of necrosis were seen. The portions not markedly affected by tumor cells showed thickened and cellular alveolar walls, the alveoli containing serum. Some round-cell infiltration was observed, indicating the presence of infection.

Pathologic Diagnoses: (1) Small-cell carcinoma of the left lung; (2) bronchopneumonia.

DISCUSSION

This case presents several interesting features. The patient had been ill over a period of five months and no suspicion of the true nature of the disease was entertained. On the basis of a diagnosis of "whooping cough," the child was sent to the contagious ward of a hospital and bronchopneumonia was then diagnosed. Had a roentgenogram of the chest been made at that time, there may or may not have been enough evidence to suggest the presence of a new growth. Even later, when the lesion was well advanced, the roentgen findings were interpreted as due to pleural fluid. The real clue to the antemortem diagnosis came when attempts to aspirate the left pleural cavity proved ineffective as far as large amounts of fluid were concerned. The small amount of sero-

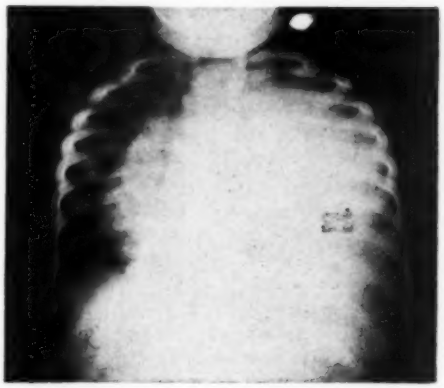

Fig. 1. Anteroposterior roentgenogram of the chest, showing a dense homogeneous shadow occupying the entire left hemithorax. The trachea and heart are considerably displaced to the right.

sanguineous material together with a few fragments of tissue indicated that the lesion might be of neoplastic origin. The possibility of a primary pleural tumor or a tumor of the lymphoid series was at first entertained. The patient's gradually retrogressive condition precluded any type of therapy which might have aided in the differential diagnosis. Not until autopsy was performed was a primary lung tumor thought of. At first, the gross diagnosis was primary sarcoma of the lung. The microscopic features were analyzed by Doctor Howard T. Karsner and the final diagnosis was primary small-cell pulmonary carcinoma.

Differential Roentgen Diagnosis: Large dense homogeneous shadows occupying an entire hemithorax and displacing mediastinal structures to the opposite side of the chest may be due to a variety of causes. The most common cause is a large collection of *fluid* in the pleural cavity. No differentiation can be made between serous, purulent, sanguineous, and bloody effusions. *Atelectasis* may produce a dense homogeneous shadow, but the mediastinal contents are retracted to the side of the lesion and the involved hemithorax may be contracted to a variable degree. *Confluent bronchopneumonia, lobar pneumonia, abscess, tuberculosis,* and *congenital cysts filled with fluid* produce dense shadows of

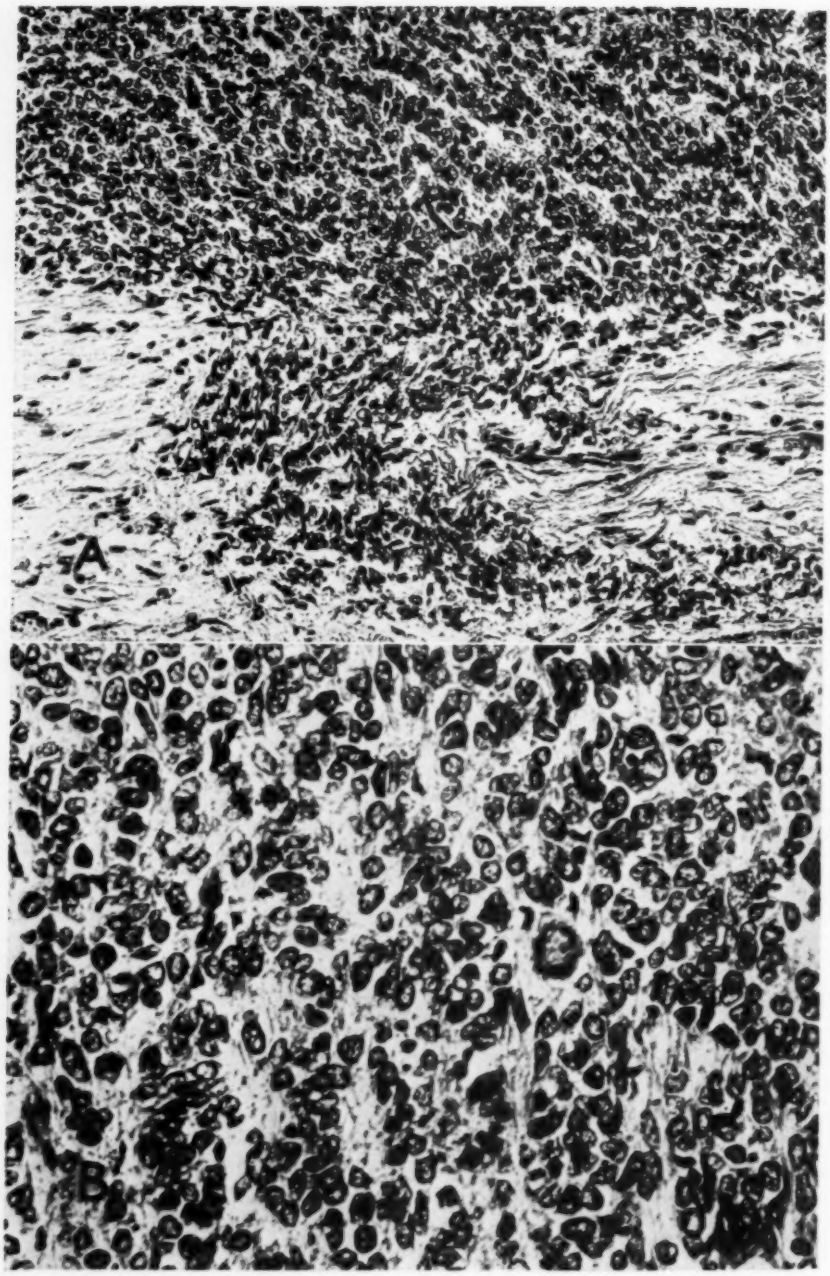

Fig. 2. A. Low power photomicrograph (×195) showing tumor cells invading the lung parenchyma, indicating the malignant character of the lesion.
B. High-power photomicrograph (×430), showing the tumor to be highly undifferentiated. The nuclei of the tumor cells are large, oval, and vesicular. There is some degree of pleomorphism. The stroma is fibrous and scant.

varying extent and usually may be distinguished from a new growth by clinical and laboratory data. The reported case demonstrates that a neoplasm may produce the same appearance as a large collection of fluid, provided the tumor is of sufficient size to cause displacement of the mediastinal structures. Several of the cases reported in the literature (1, 2, 4, 5, 12) showed a roentgenographic appearance similar to the one reported here, and in several instances the erroneous diagnosis of pleural effusion was made instead of one of neoplasm. Thus, it seems obvious that a diagnosis of primary bronchogenic carcinoma must always be considered in the differential roentgen diagnosis of large, dense, homogeneous shadows involving one side of the chest.

Etiology: As to the etiology of primary bronchogenic carcinoma in the young, no definite statement can be made, but one may speculate on whether the lesion is congenital or acquired. Schwyter's case of squamous-cell carcinoma in the lining of a congenital pulmonary cyst suggests that epithelial tumors occurring so early in life originate on the basis of some congenital malformation. The few other cases found in the literature offer no clues as to the cause of the neoplastic growth. Because of the occurrence at such an early age, Cohnheim's theory of renewed activity of embryonal cell rests may be applicable. Also, the rarity of these tumors in infancy would argue against an acquired origin, especially since a factor of chronic irritation cannot be found. The possibility of development of carcinoma on the basis of vitamin A deficiency is suggested by the work of Wolbach and Howe (19), in which they showed hyperkeratinizing effects on the bronchial epithelium. Wintemitz, Wasson, and McNamara (18) have shown that epithelial proliferation of the bronchi following influenza can hardly be distinguished from invasive carcinoma.

Treatment: The logical approach to the treatment of primary bronchogenic carcinoma in infancy would be the same as for the disease in adults. The choice of treatment depends upon the stage in which the diagnosis is made. If the tumor is found, by roentgen studies, to be small and peripherally situated, pneumonectomy would be the procedure of choice. No case treated in this manner has as yet been recorded in the literature. In the advanced stage of the disease, where the extent of involvement precludes surgical removal, high-voltage roentgen therapy may prove of benefit from the standpoint of palliation. When exploration of the chest indicates that the lesion is inoperable, roentgen therapy should be resorted to if the patient's general condition warrants it.

SUMMARY

1. Primary cancer of the lung in *infancy* is a rare disease. A review of the literature reveals reports by only three authors, *viz.*, McAldowie, Schwyter, and Beardsley.

2. Primary carcinoma of the lung in *childhood* and *early adulthood* is also of relatively rare occurrence. Only a few reports are found in the literature.

3. A case of primary small-cell carcinoma of the lung in a 17-month-old girl is reported in detail, with roentgenographic and pathologic findings.

4. The differential roentgen diagnosis indicates that carcinoma is most commonly mistaken for massive pleural effusion.

5. It seems more probable that primary bronchogenic cancer in infancy develops on a congenital basis than on an acquired one. Avitaminosis A and influenzal infections may be factors in the production of metaplasia of bronchial epithelium with subsequent development of cancer.

7. The logical treatment of cancer of the lung in the young is surgical extirpation when the lesion is of small size and situated peripherally. It is possible that palliation may be obtained by high-voltage roentgen therapy in the later stages of the disease.

Grateful acknowledgment is made to Dr. Thomas C. Laipply for his excellent photomicrographs, and

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DISCUSSION

(Papers by Howard P. Doub and Horace C. Jones and Harry Hauser)

Edward J. Meister, M.D. (Denver, Colo.): Discussing first endothelioma of the pleura, we find, as pointed out by Dr. Doub and Dr. Jones, that these tumors are relatively uncommon. The question as to their origin has given rise to many differences of opinion, and the controversial nature of the subject has been properly stressed.

It appears that the chief questions arise in the differentiation of (1) bronchogenic carcinoma, with extension to pleural surfaces, (2) tumors arising from the endothelial lining of subserosal lymph spaces, and (3) tumors arising from the mesothelium or serosal cells proper.

It would seem theoretically possible for each of these types to occur. Therefore, to advocate the use of one term for all, or one conception as to the origin of the entire group, may be in error. I merely wish to point out again that much difference of opinion exists in this connection and that often the pathologist, faced with a highly anaplastic tumor, finds it difficult to reach a conclusion which will be acceptable to others.

From the standpoint of clinical diagnosis, it is now obvious that the use of air injection following thoracentesis is highly desirable. It seems to me that this deserves to be re-emphasized. On the other hand, if a single or multiple tumor of the pleura has been demonstrated roentgenographically, it should be remembered that in most instances these will represent metastatic growths originating from a tumor outside the chest. Therefore, a careful search should be made for a possible silent primary tumor elsewhere. The second most common cause of tumor involving the pleura will be primary carcinoma of the lung, which may on occasion show very little, if any, central involvement. For this reason, it seems to me that bronchoscopy should not be lightly dismissed. The incidence of proved primary bronchogenic carcinoma with obvious involvement of the bronchi runs somewhere between 1 and 2 per cent in large postmortem series, and a definite attempt should be made to rule out this more common condition. I am sure that the essayists merely wished to mention that, in retrospect, bronchoscopy could not have demonstrated the lesion in their cases, but this very fact, it seems to me, should make the procedure, in spite of all of its shortcomings, of value in arriving at a differential diagnosis.

Turning now to Dr. Hauser's paper on carcinoma of the lung in infancy, I wish merely to discuss one point. Growth of malignant neoplasms ordinarily appears to be initiated by and to require the combined presence or action of both intrinsic and extrinsic factors. The intrinsic group includes the factors of heredity, organ susceptibility, general susceptibility, and so on. Cell rests may also be included. The extrinsic group includes the factors of irritation of various types, hormonal influences, etc. Certain tumors may occur in the fetus and become well developed prior to birth. At least one of these, the retinoblastoma, has been shown to have a very marked hereditary tendency. Having considered these points, as well as many others, Boyd implies that it may be possible for the intrinsic factors to be so dominant that very little, if anything, in the way of an extrinsic excitant may be necessary to initiate malignant growth.

Radium Poisoning[1]

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RADIUM POISONING is of sufficient rarity and importance to warrant report of every case with as much detail as possible.

From cases already reported by Blum (1), Hoffman (2), Martland (3), and others, from 1924 down to the present, much has been learned regarding the distribution of radioactive material in the body, its degree of elimination in the first few weeks, and the amount of fixed retention after a lapse of six months to two years. The tolerance dose would appear to be an individual matter, depending upon the concentration of the deposit, the tissue or organ in which it is deposited, and the natural sensitivity or predisposition of the tissue involved or the general constitution of the patient. It is conceivable, too, that dietary habits and general environmental conditions may play an important rôle in the final outcome when radioactive salts have been taken internally.

In most of the reported cases the dose of radium administered has not been accurately known, or the patient has not been followed very long, or the amount retained over a long period has not been accurately measured. It should be noted, too, that there is a vast difference, as pointed out by several authorities, between the percentage of permanent fixation in the tissues when the radium has been administered by mouth, when it is absorbed by inhalation, and when it is injected intravenously. Rajewski (4) says that, in order to have a residual deposit of 1 microgram, at least 100 micrograms would have to be taken by mouth but only 20 micrograms (one-fifth as much) by inhalation or intravenous injection.

Norgaard (5) published a case of radium poisoning, with necrosis and finally sarcoma, following injection of radium into arthritic joints. Gettler and Norris (6), Martland (7), and others report poisoning from radioactive water, manifested as necrosis of the jaw, while many instances of primary carcinoma of the lung have been described in miners working in radioactive mines.

In animals receiving injections of radioactive material (Rosenthal, 8), osteomyelitis and necrosis developed in the jaw, a conspicuous feature being the fairly early appearance of cysts, arising in the periodontal membrane, later becoming pustules, and finally destroying all the structures of the teeth and jaw. There was also gingivitis of a hypertrophic character, suggesting papillomatous development, and malignant changes sometimes followed.

As is well known, various types of malignant growth have followed infections of bone, or have developed primarily in radium poisoning.

The following history seems to me to be worthy of report.

The patient, Mr. H. B., was a thirty-six-year-old white man, a commercial photographer, who stated that he had always been well except for night sweats, which he had experienced since early youth. There were no chills and rarely was there any rise of temperature. One summer, he said, he took his temperature every morning and evening and only occasionally observed a very slight rise. He worked hard every day. No one had ever suggested the possibility of tuberculosis, and he had never consulted a physician. He maintained a normal weight. In the spring of 1924 he first noticed enlarged lymph nodes on both sides of the neck, and in the axillae and groins.

He consulted Dr. E. Panzner, of Detroit, in July 1924, who removed a node from the neck for histological study. The report, by Dr. James E. Davis, was as follows:

[1] Presented before the Radiological Society of North America at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

"The specimen is a small gland 1.5 × 12 mm. in size, encapsulated, of uniform structure, characteristic of a lymph gland. One small area shows evident degenerative changes. Three sections were taken. The structural unit consists of lymphocytes, endothelial cells, and a relatively small number of connective-tissue cells. The structural arrangement of the units is fairly closely imitative of lymph gland. There are, however, a few follicles with discernible germ centers. The main deviation from normal lymph glands is a production of stroma of fairly marked prominence containing many endothelial cells and atypical atrophic connective-tissue cells of marked instability and numerous fairly large areas of necrosis (caseation type). Numerous new vessels have been formed. Anaplasia of cells is particularly present in the areas of richer stroma production. The entire tissue is indicative of rapid new growth. The capsule is densely infiltrated with new growth cells. *Diagnosis:* Hodgkin's disease."

Clinically, also, the case could be correlated most closely with that type of lymphoblastoma designated as Hodgkin's disease. There were enlarged nodes in the right side of the neck, in both axillae and both groins. Roentgen examination showed a widening of the mediastinum due to the presence of enlarged nodes.

Recently the patient stated that both before and after coming to us he had always had a liberal diet of vegetables, milk, fruit, meat, eggs, etc., so that he was getting plenty of calcium in his food.

X-ray treatments were begun on July 29, 1924, with a Victor 200 kv. machine and air-cooled high-voltage x-ray tube, 50 cm. distance, 1 mm. copper and 1 mm. aluminum filter, 30 ma., 10 × 20 cm. fields over the left side of the neck and left axilla, 12 minutes. The following day, July 30, 1924, similar doses were administered to the right and left groin and lower abdomen, and on July 31 a like amount was given to the mediastinum, right side of the neck, and right axilla. Each of these doses I later calculated would be somewhere around 400 r. This treatment resulted in a marked diminution in the size of most of the nodes. The only ones which were really palpable on Oct. 14, 1924, two and a half months later, were some in the neck.

On Jan. 7, 1925, roentgen examination of the chest showed continued enlargement of the mediastinum. There was also a moderately diffuse peribronchial infiltration in the region of the 5th, 6th, and 7th intercostal spaces, which Dr. Hans Jarre and I, at that time, thought to be of neoplastic origin. Respiration was rapid and difficult. Treatment had not relieved this condition as well as it had the palpable nodes in the neck and groin. After a study of the literature then in existence on the internal use of thorium and radium, we felt justified, therefore, in injecting radioactive salts into the blood stream, as had been done in Europe. Wm. Cameron in this country had injected large quantities of radium without any apparent bad results and had recovered a large proportion of it from the urine and feces in the first two weeks. We therefore concluded that a sufficient amount of radium might be eliminated to make the treatment safe. We considered the experiment justified, also, on the ground that we were treating a disease for which there was no known cure, and which always proved fatal in a few years. The observations of Blum and Martland, which led later to a more detailed study of radium poisoning, were published only in 1924 and 1925.

On Jan. 21, 1925, we injected intravenously 20 micrograms of radium chloride. On Feb. 12, roentgen examination of the chest showed a pronounced increase of the transparency of the lungs as compared with the previous examination, Jan. 7, 1925. Respiration was improved, but we believed that more radium was indicated. The right diaphragm was high. On March 4, 1925, we injected intravenously 50 micrograms of radium chloride.

Re-examination of the chest, April 16, 1925, gave the impression of normal thoracic organs, except that the right diaphragm was still higher than normal. Subsequent check-ups, in June and July 1925 and March 1926, showed the diaphragm to be still a little high. Early in 1926 the patient complained of nausea and epigastric distress, and fearing the presence of some lymph node involvement in the upper abdomen, we gave x-ray treatment to this region, Jan. 7 and 8.

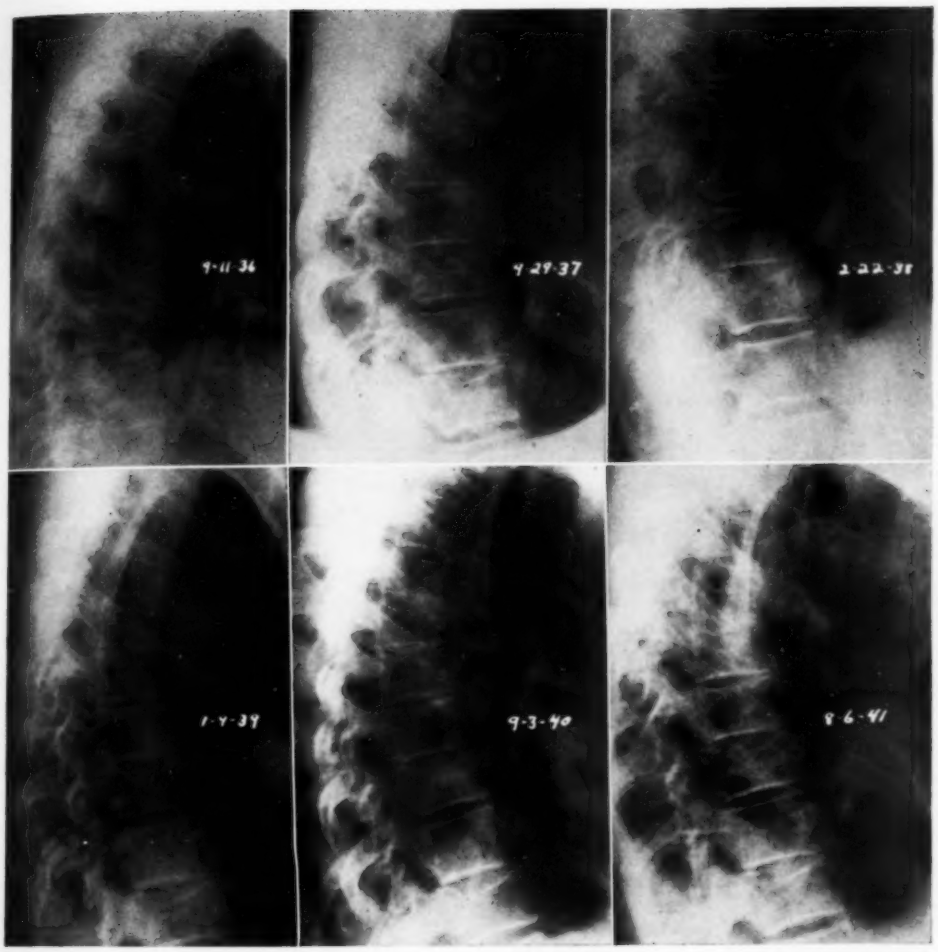

Fig. 1. Successive roentgenograms of the dorsal spine, showing destructive lesions at first attributed to Hodgkin's disease but later found to be due to radium poisoning.

On May 2, 1926, the right diaphragm still being high and symptoms persisting, we gave another 50 micrograms of radium chloride intravenously. Later the injections of radium chloride recorded were as follows:

July 27, 1926	20 micrograms
April 12, 1927	50 micrograms
May 31, 1927	50 micrograms
Aug. 23, 1927	50 micrograms
Nov. 29, 1927	50 micrograms
May 14, 1929	50 micrograms
Nov. 24, 1930	50 micrograms

A grand total of 440 micrograms was thus given in five and three quarter years, from Jan. 21, 1925, to Nov. 24, 1930. These injections were given for various symptoms that appeared from time to time, particularly attacks of persistent vomiting, occasional enlarged nodes in the neck, fever of 100 to 101°, night sweats, and attacks of sudden severe sharp pains in the eyes followed by fleeting blindness. Ophthalmologists could not discover any eye trouble to account for the ocular symptoms and these were not relieved by x-rays. It was for them that we gave the last dose of radium, in November,

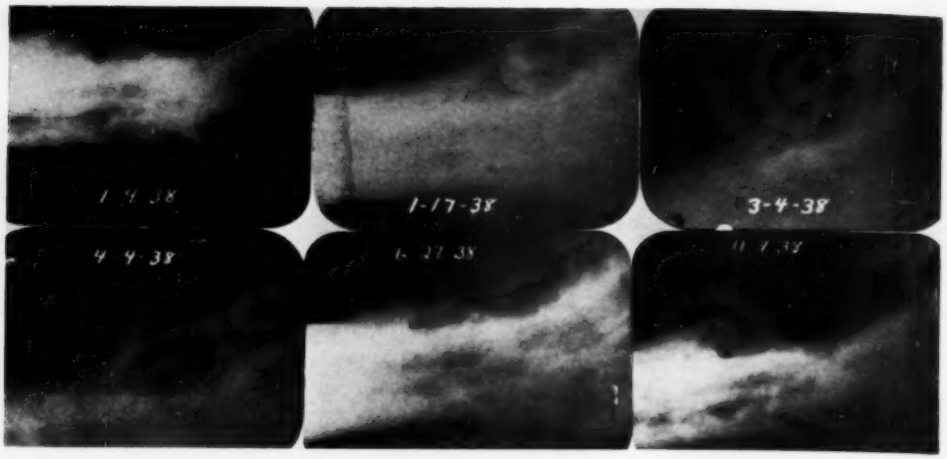

Fig. 2. Dental films showing necrotic area in the jaw.

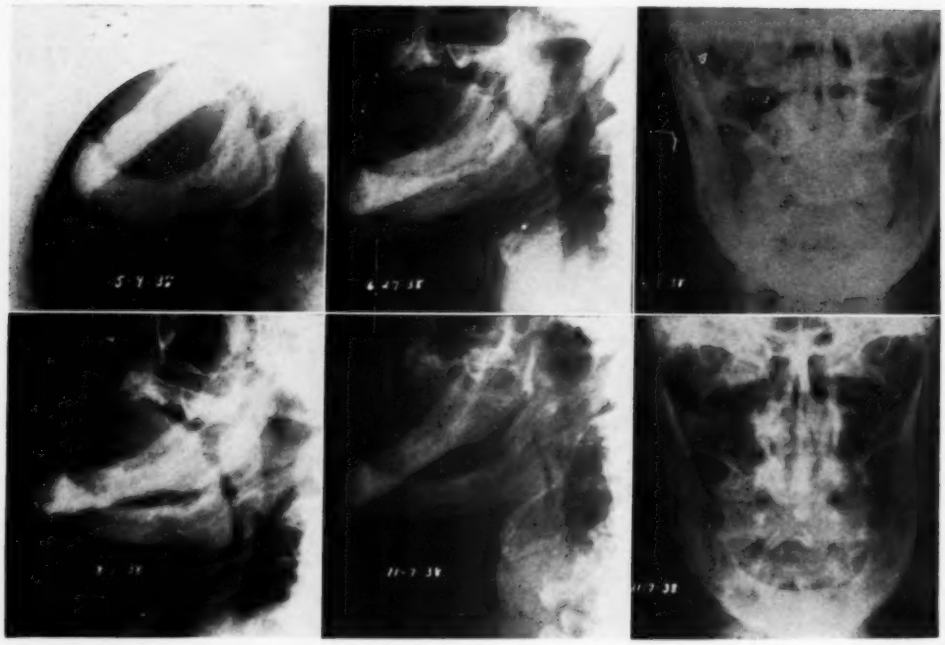

Fig. 3. Roentgenograms taken in 1938, showing progressive necrosis of jaw.

1930. Relief soon followed and there was no recurrence of this trouble.

In June 1937 the patient had a severe attack of herpes zoster involving the right abdominal region. Since 1936 he had been wearing a brace because of partial destruction of the body of the tenth dorsal vertebra (Fig. 1), and he had also received some x-ray treatment to this region because we thought, at the time, that the lesion might be a manifestation of Hodgkin's disease. Later, however, when osteomyelitis developed in the mandible and evidence of considerable radium was found

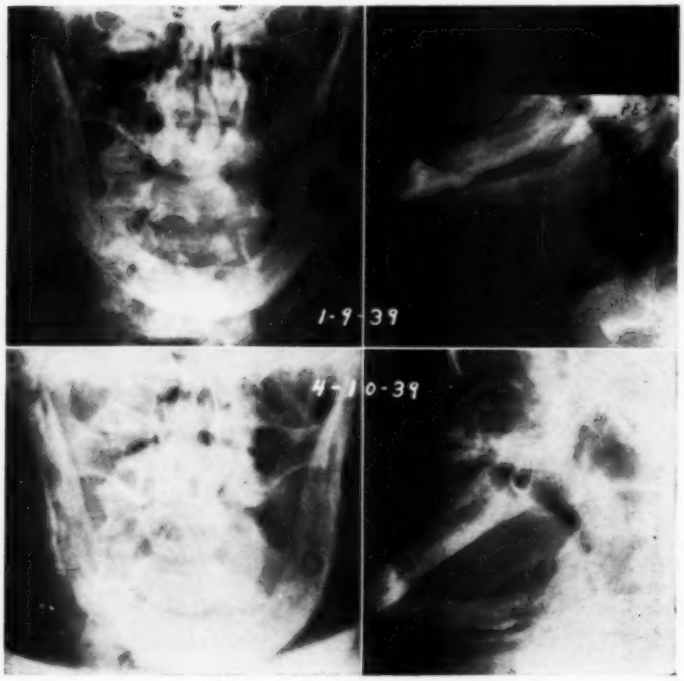

Fig. 4. Necrosis of jaw, 1939.

in the spine and jaw, we were of the opinion it was due to radioactivity.

On June 4, 1938, a dentist, Dr. Martin Debats, who had removed some of the patient's teeth from time to time, found a necrotic area in the jaw (Fig. 2) in the region of lower right third molar which was causing some distress. At this time we finally persuaded the patient to have an examination for radioactivity, sending him to the University of Michigan to Dr. Baldwin Curtis, Physics Department, who gave us the following report:

"A number of readings were taken along the spine and cheek and may be tabulated as follows:

Position	Counts per 5 minutes
Left cheek	494
Right cheek	462
Neck	409
First vertebra	379
Third vertebra	325
Fourth vertebra	304
Fifth vertebra	293
Lower spine	281

"This evidence indicates that there is more radium present in the skull and jaw bones than in the spine, although the results of other workers, such as Evans, show that radium is usually more concentrated in the middle of the back than elsewhere.

"The technique of measuring has not yet been sufficiently perfected to determine the exact amount of radium present in one who has been injected with it. However, from previous experience with such cases, using my measurements and medical reports of the amounts injected as a basis for judgment, I would say that Mr. B. has been given between 20 and 160 micrograms of radium, the actual figure being probably about 150 micrograms."

The pain increased, necrosis soon involved the right side of the mandible, and the jaw became fixed. It was difficult to get even liquid food into the mouth. Suffering for months was severe, but the patient continued at his work daily, as he has done during the entire period—seventeen and a half years—that he has been under our care.

In August 1938 Dr. Debats tried to get a section of bone from the jaw, but obtained only a very small sequestrum, which our

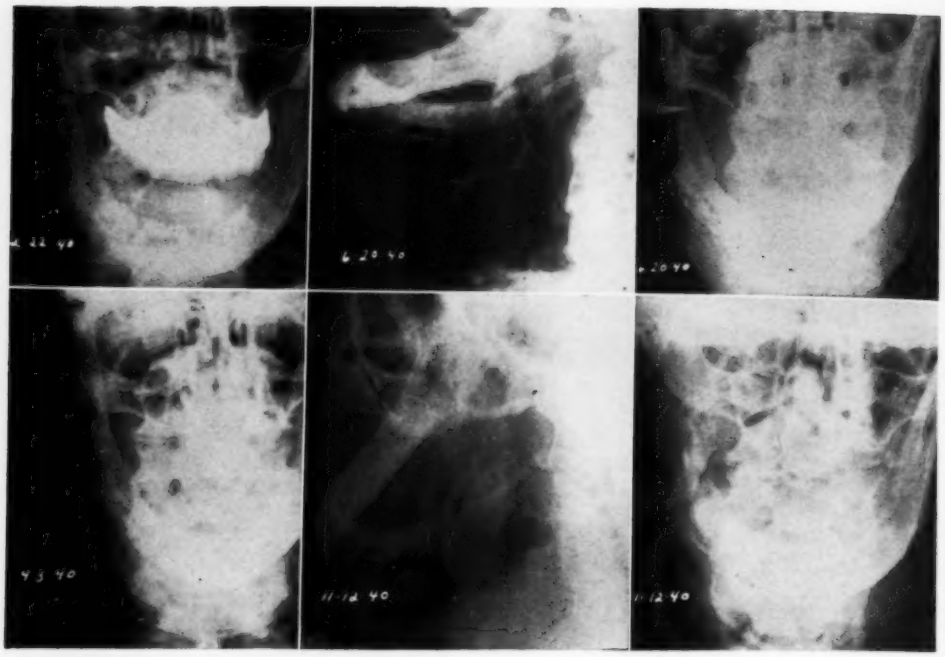

Fig. 5. Necrosis of jaw, 1940.

pathologist, Dr. Clarence I. Owen, examined and reported as necrotic bone. Necrosis gradually extended (Figs. 3–6).

Finally I got in touch with Dr. J. C. Aub (9–11), who had been conducting experimental work on calcium metabolism, especially in its relationship to lead poisoning. In the course of his work he thought his findings might apply to radium poisoning and he reported a case which had been greatly improved and in which the necrotic jaw had been restored by eliminating radium through restricting the amount of calcium in the diet and administration of parathormone, thyroid extract, and ammonium chloride. We prescribed this course of treatment except the parathormone, which Dr. Aub thought unnecessary.

The calcium-free diet in this case consisted of bread made without milk, all meats, cereal with whipping cream (no milk), distilled water (2 glasses a day), and coffee made with water thoroughly boiled. The only vegetables permitted were tomatoes and raw cabbage.

In three days the pain was almost completely relieved, so that cobra venom, aspirin, and codeine, which the patient had been taking, were no longer needed. A large sequestrum projected from the jaw and the patient himself removed it soon after beginning the Aub treatment. It measured 6.5 × 1.5 cm. We received the sequestrum in July and examined it on July 22, 1940, with our Geiger counter, but found no gamma rays. Dr. Lawson of the Physics Department of the University of Michigan also examined it, with negative results. It was then sent to Dr. Robley Evans of the Massachusetts Institute of Technology, who reported that by gamma counter he discovered no gamma radiation. Later, by dissolving the bone and using the photographic method, he found that the radium content of the dry bone of the specimen, which weighed 0.525 grams, was about 2 micrograms.

The patient still had other sequestra in the mandible, and there was a large discharging sinus. X-ray examination, Sept.

Fig. 6. Necrosis of jaw, 1941.

3, 1940, showed about the same degenerative changes in the 8th, 9th, 10th, and 12th dorsal vertebrae as previously observed (Fig. 1).

On Nov. 12, 1940, the patient reported that he had been free from pain for a year and was eating anything he desired, a well balanced diet, having discontinued the calcium-free diet six months before. On the above date, he returned from Cambridge, where he had had a thorough examination by Dr. Robley Evans, who reported as follows:

"The analysis of breath samples of Mr. B. have now been completed and all calculations made for his case. The gamma radiation as determined with counters, according to the method described in my paper in the *American Journal of Roentgenology* in March 1937, shows the presence of 7.2 micrograms of radium, giving gamma radiation. The body also contains an additional amount of radium which accounts for the production of 105×10^{-12} curies of radium per liter of exhaled air. Taking a normal respiration rate of 5 liters per minute, this corresponds to an additional 4.2 micrograms of radium. Thus the total radium now in Mr. B's system is 11.4 micrograms."

Roentgenograms at this time, Nov. 12, 1940, showed a loose sequestrum consisting of the coronoid process and adjacent mandibular ramus; also another fragment involving the lower margin in the molar and bicuspid area.

Subsequently the patient again began to have severe pain and for a second time he was placed on the calcium-free diet and given ammonium chloride and thyroid extract, as before. Again within three days after institution of this diet his pain was relieved and has not recurred at this writing, eight months later. The patient him-

self recently removed a second large sequestrum which had been protruding from a fistulous tract for several weeks.

Recently he discontinued the use of the brace for his spine, which he had worn continuously for over five years, and he now suffers no discomfort. He has a good appetite, is working daily at commercial photography, is maintaining his usual weight, and does not present any evidence of Hodgkin's disease. His blood picture throughout the eighteen years has hardly deviated from normal. Occasionally there have been 4 or 5 per cent of eosinophils. There is no sign of malignancy. In spite of a large fistulous tract leading through the mandible to the mouth, and in spite of no teeth, natural or artificial, being present in either the upper or lower jaw, the patient manages to masticate pretty well with his tongue and keeps fluids and solid food from flowing out through the cheek.

The patient is happy and contented and says that, even had he known about the poisoning that was to come in time, but which would probably cure the Hodgkin's disease, he would have taken the treatment just the same, because he has led a happy and useful life during the eighteen years. He and his wife, who works with him, have done much for the high school students in his little town, in a social and educational way. His shop has for many years been a rendezvous for the students and furnishes an opportunity for the study of photography. In a recent issue of the high school journal the students paid him great honor. I mention this because I feel that the preservation of his life has been due as much to his fine, intelligent co-operation at his home, 200 miles from my office, through these trying years as to any treatment we may have given him.

COMMENT

Dr. Robley Evans in a comment on this case stated: "His case now constitutes one of the very few instances in which adequate data exist on the amount [of radium] injected, and on the amount retained after a period of many years. The fractional retention amounts to 11.4 micrograms out of a total administration of 440 micrograms, or 2.5 per cent. This figure is in good agreement with the average value from a great many less accurately known cases." According to Dr. Aub, this amount of retention is regarded as more than a fatal dose. Rajewski says that 1 microgram is sufficient for destructive action, and the destruction is probably due to a concentration of alpha particles, whose energy is many times more potent than the relatively scarce gamma and beta rays. We would expect, therefore, that more destruction must go on in our case and terminate in serious anemia if not in another type of malignant growth. Or may it be possible that the chemical processes which gradually led to the apparent cure of the Hodgkin's disease may have produced in the patient's body cancer-resistant materials, and so have counteracted instead of favored any carcinogenic tendencies of the radiation?

If this case of Hodgkin's disease is cured by this natural radium which has been active in the body many years, what may be hoped for from the artificially produced radioactive elements, as, for instance, radiophosphorus? This man had symptoms for six years, of which it would be impossible to say whether they were all due to Hodgkin's disease or to radium. Would continuous use of radioactive isotopes over a period of several years be likely to produce a poisoning akin to that caused by natural radium?

We wonder, too, how the calcium-free diet, ammonium chloride, and thyroid, relieved the patient's pain so speedily. Dr. Aub's original idea was to remove calcium from the bones and with it the radium, which has an affinity for calcium similar to lead, but in talking of this case he expressed his doubt that anything of the kind could be accomplished here, since the radium would long ago have been fixed in the cortex of the bones, which could not be robbed of their cortical calcium by the treatment prescribed, or by any known treatment, and apparently this is so. How,

then, was the relief from pain brought about so quickly and completely, both in this case and in an early case of Dr. Aub's? Prompt relief of constant, very severe pain took place on two occasions several months apart in our patient. Was it the diet alone? Or did the exclusion of the calcium from the metabolic processes permit an otherwise impossible physico-chemical reaction on the autonomic nervous system, which resulted in analgesia?

What physico-chemical reactions may have been going on in this patient's bones, during these eighteen years, that are different from the normal, that could produce the destruction which we have observed? The answer, I believe, is well on the way from Berkeley. Is there not in this patient's system a natural cyclotron laboratory, which has been operating every moment continuously for more than eighteen years? Is there not being performed before our very eyes a great experiment in physico-chemico-bio-physiology?

As I look at it with my young, untrained mind, it seems to me that in this patient we have a piece of ready-made apparatus, one of Nature's cyclotrons operating many years in the greatest of all biochemical laboratories—the living human being. The cyclotronic element, radium, is shooting out vast amounts of energy in the form of alpha and beta corpuscles and gamma rays at around two million electron volts, itself thereby undergoing transmutation into radioactive unstable, as well as stable, isotopes. Probably most of the known elements are present within range of its large numbers of atom-smashing alpha particles as well as the less energetic, but also very destructive beta and gamma rays. The alpha particles are surely knocking out neutrons from the nuclei of atoms of the beryllium present in the human body, which may thus transmute other elements in the body by penetrating other atomic nuclei, so that we have constantly changing biochemical reactions going on all the time.

Similarly hundreds of other atomic and molecular changes must surely be taking place through the multiplicity of chemical reactions brought about by the many different types of radioactivity resident in and derived from the radium still present in this man's body, and acting upon infinitesimal and larger particles of the elements.

It will take many years to separate and solve some of these complex problems, but it would seem that here and now is a good place and time to begin on a case of radium poisoning, where we have some fairly accurate knowledge of the amount of radium taken in some eighteen years ago and that now remaining, and to co-ordinate experimental data with clinical data.

Is it too fantastic a dream to look into a future when with the help of the modern cyclotron and other physico-chemical means it will be possible to interrupt this chain of events initiated by radium taken into the animal body? These suggestions no doubt may seem wholly impractical to the scientists here assembled, and the object aimed at may never be attained, as is often the case; but, as is also often the case, something more important than the original object may be accomplished.

Let us adopt Edgar Guest's title of stories of great accomplishment:

"It Can Be Done."

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Granulomatous Jejuno-Ileitis[1]

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GRANULOMATOUS jejuno-ileitis is a primary inflammatory disease of the small bowel of indeterminate origin, involving both jejunum and ileum in varying degrees. It may be acute, subacute, chronically active, or chronically inactive. The chronic phase is granulomatous with a microscopic appearance similar to that found in regional enteritis or, as it is otherwise known, terminal ileitis. The definition is perhaps clarified by the following classification of inflammatory diseases involving jejunum and ileum:

1. Specifie infections.
   Tuberculosis, typhoid, cholera, paratyphoid, and salmonella.
2. Specific non-infectious lesions.
   (*a*) Radiation fibrosis
   (*b*) Vascular occlusions
      Generalized arterial disease, *e.g.*, periarteritis nodosa, lupus
      Multiple localized infarctions
      Impairment as result of obstruction
   (*c*) Parasitic lesions
   (*d*) Lesions due to drugs
   (*e*) Jaundice and toxic hepatitis
   (*f*) Blood dyscrasias, agranulocytosis
3. Secondary non-specific infection developing in long-standing deficiency cases, such as tropical sprue.
4. Acute ulcerative or necrotic jejuno-ileitis associated with uremia, hemorrhage, operative trauma, etc., thought by some to be due to compensatory spasm of the terminal arterioles ("shock lesions").
5. Acute phlegmonous disease associated with portal obstruction.
6. Jejuno-ileocolitis of infants.
7. Granulomatous jejuno-ileitis.

ETIOLOGY AND PATHOGENESIS

The etiology of granulomatous ileojejunitis is unknown. It is impossible to determine, for example, whether the disease represents a primary infection or occurs secondarily in a patient with deficiency disease. The fact that some observers (7) have described inflammatory changes of varying degrees in cases both of tropical and non-tropical sprue might suggest the latter pathogenesis. Opposed to this view is the fact that stenosis has never been described in the deficiency state (8). Since the histologic findings are precisely those observed in terminal ileitis (2), it is quite possible that the disease extends from an original lesion in the ileum or that it is a diffuse form of a condition which is usually more localized. Two of our patients gave a history of colitis. Whether this has any bearing on etiology is impossible to determine, though it is worthy of note that the terminal ileum is involved in a high percentage of cases of advanced colitis. The pathological process, however, differs from that in the granulomatous disease. On the other hand, the connection may not be a direct one, since Mackie (5) described a deficiency small bowel pattern in ulcerative colitis.

Since the etiology and method of spread in jejuno-ileitis are unknown, the disease is best regarded for the present as a clinical and roentgen entity.

INCIDENCE

The present study includes 23 cases. Three further cases were available which did not entirely conform to the remainder of the group and were therefore not included in the analysis. Four cases were studied postmortem. Eight patients were operated upon, and in 3 instances specimens were removed for microscopic examination. The remaining 11 cases were considered characteristic from clinical and roentgen points of view. Six of the present series were included in the excellent study of Crohn and Yunich (3).

The average age of the patients was 27 years; the youngest was 9 years of age, the oldest 65. Eighty per cent of the cases occurred between the ages of 15 and 35

[1] Read before the Eastern Conference of Radiologists, New York, N. Y., January 1942.

years, with an average age of 20 years. There were 3 males to 1 female. Eighty-five per cent of the patients were born in the United States, the remainder in Central Europe.

CLINICAL DATA

Diarrhea and abdominal pain were the two outstanding symptoms on admission to the hospital. Diarrhea occurred in 21 of the 23 cases, with sometimes as many as fifteen movements a day. The stools were usually watery, loose, or non-specific in character. In 4 cases they were bulky, foamy, or greasy, or otherwise similar to the stools in intestinal insufficiency: in 2 cases they were black or blood-tinged. Seventeen patients complained of abdominal pain, often referred to the right lower quadrant. The pain was cramp-like and occurred particularly during a period of diarrhea. It bore no relation to meals.

Fever, vomiting, and weight loss were occasional presenting symptoms (25 per cent). Edema of the ankles, pallor, anorexia, asthenia, and constipation alternating with diarrhea were seen in individual cases.

The average duration of symptoms prior to admission was two years, with a range from three days to eight years. Most cases, however, fell within the middle 75 per cent, with an average duration of a vear and a half.

Appendectomy had been performed in 8 cases (33 per cent). In 7 the operation was done for right lower quadrant pain, which was a presenting symptom. There was an allergic history in 4 cases (16 per cent). One patient had had celiac disease in childhood. In one case, clinical symptoms had suggested ulcerative colitis; the roentgen examination of the large bowel had shown mild changes. Slight changes in the small bowel had been attributed to a deficiency state.

Most patients (90 per cent) had lost weight, up to 90 lb. in one instance. The average loss for the 23 patients was 14 lb. In 60 per cent of the series the temperature was elevated, the usual range being between 100 and 102° F.; in some cases it reached 104°. The temperature was usually above normal in those with acute and chronically active disease. Diarrhea, as stated above, was a fairly constant feature, with the stools usually watery or liquid. An average of 4 stools a day was observed. In half of the cases in which the stools were examined for fat content (8) this was found to be higher than normal; in one case it was 69 per cent. In 18 cases, stool cultures were made. No abnormality was noted in 16. In one the Flexner bacillus was grown once at the onset of the disease but not later; in one typhoid bacilli had been found two years before, when the patient was considered to be a typhoid carrier.

Right lower quadrant pain, vomiting, and malnutrition were observed in about 40 per cent of the series. Signs of obstruction were present in 4 cases, and in 2 of these they reappeared, requiring readmission. Abdominal distention and tenderness were present in about equal proportion (25 per cent). Twenty-five per cent of the patients had perianal abscesses with or without fistula.

An interesting finding was clubbing of the fingers, in 40 per cent of the series. In 8 cases there was infantilism or hypogenitalism. In only 2 cases was a glossitis noted; there were no other evidences of avitaminosis.

LABORATORY DATA

Anemia was not a prominent feature. In 10 cases (40 per cent) the hemoglobin exceeded 80 per cent. In only 2 cases was there a macrocytic hyperchromic anemia. Polymorphonucleosis, with a count exceeding 10,000, was present in half the patients; an eosinophilia exceeding 3 per cent was present in 8 (33 per cent). No abnormal blood agglutination was elicited except in the case in which the Flexner bacillus was discovered in the stool.

Intestinal insufficiency, as evidenced by an abnormal Janney test, was found in 6 cases. In 3 of these, however, the glucose tolerance was only slightly changed. The

blood calcium level was below 9 mg. per cent in 5 cases (20 per cent). In only one instance was osteoporosis demonstrated. A Rehfuss test meal was given in 13 cases. Free HCl was absent in 3 (25 per cent), and was reduced in 2 others. Sigmoidoscopy showed no abnormalities except for slight changes in the rectal mucosa in 2 patients.

Tuberculosis appeared unimportant as a factor in the disease. Roentgenograms of the chest were made in 8 cases. They were entirely normal in 7 and showed calcifications in one. The von Pirquet test was positive in 3 cases and negative in 6. In the 6 cases investigated, no tubercle bacilli were found in the stool.

PATHOLOGICAL FINDINGS

Acute Stage: The submucosa is intensely inflamed, edematous, and thickened. Acute greenish ulcerations are present in the mucosa, with infiltration, usually by polymorphonuclear leukocytes. The mesentery shows edema and thickening.

Subacute Stage: The mucosa is hypertrophied and granular, and there is punched-out ulceration. The ulcers have smooth or irregular edges and may be longitudinal or transverse. There is early polypoid proliferation. No definite stenosis or rigidity is observed. Of greatest importance is the presence of segments of normal small bowel, so-called "skip areas." The mesentery is thickened. There are many individual enlarged nodes.

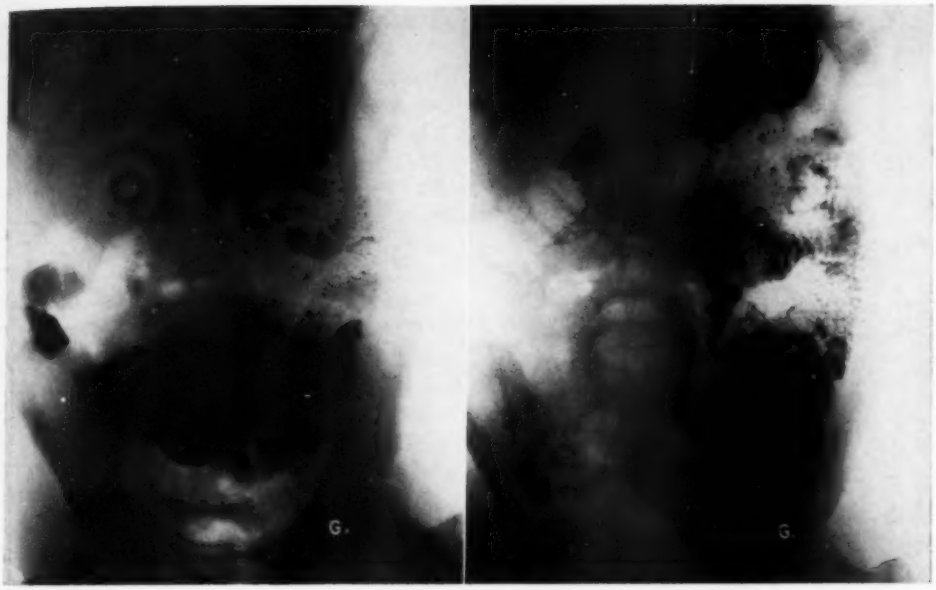
Chronic Stage: The wall of the affected segments of small bowel is thickened, with marked submucosal fibrosis. The mucosa has a cobblestone appearance, with multiple polyps and depressed scars. There may be alternating atrophic and hypertrophic areas. Multiple areas of stenosis are present. The serosa and mesentery are thickened, and the latter may be retracted. Activity is indicated by fresh ulcerations and a shaggy exudate on the serosa. The chronic stage is also characterized by "skip areas" of apparently normal small bowel. In our series the disease often affected the terminal loop of ileum but this was not a constant finding (only 60 per cent). Although cases of localized jejunitis have been seen by us and have been reported in the literature, none is included in the present series. In no instance were there abscesses or fistulae communicating with the small bowel. Six patients had perianal abscesses and fistulae, which originated in the anus or rectum.

In the 12 cases examined postmortem or at laparotomy, 3 showed abnormalities of the colon. In one, an ulceration was present in the cecum; in another the cecum was thickened. In the third, lack of haustration was observed postmortem. Of the remaining 11 cases, which were investigated clinically only, 2 showed loss of haustration in the descending colon with some irregularity in the mucosal pattern. Two showed slight dilatation of the large bowel. In one, a small patch of non-specific inflammation was seen proctoscopically.

ROENTGEN FINDINGS

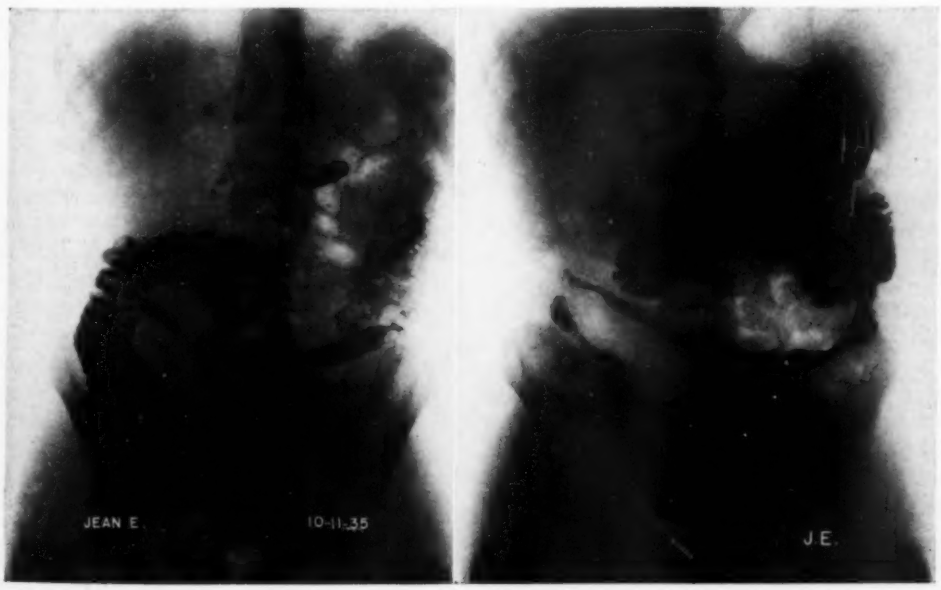
The roentgen findings closely follow those observed pathologically. In the acute phase, differentiation from the non-specific abnormalities described in avitaminosis, sprue, etc., cannot be made. There is patchy segmental distribution of the barium throughout the small bowel. The valvulae conniventes appear farther apart. The outline of the barium-filled jejunal loops is hazy. The loops of ileum show uneven peristaltic activity and lack flexibility. Even in this acute stage, however, there sometimes can be distinguished normal loops between others that appear abnormal. The terminal ileum appeared to be involved in about half of our acute cases.

In the subacute phase, the jejunal loops show more pronounced alterations in contour. The barium is not distributed evenly and there appears to be irritability, since the barium passes rapidly from loop to loop so that it is difficult to obtain a mucosal pattern. In the ileum the loops appear thickened and more rigid. There is a marked discontinuity in the barium as it is deposited on the mucosa, so that the



Figs. 1 and 2. Case 1: The patient was a 19-year-old white male, with a history of diarrhea, abdominal pain and fever. The roentgen appearance of the small bowel on admission (left) is indistinguishable from that of a deficiency state. The patient was suffering from an early acute phase of granulomatous jejunoileitis.

Three years later a roentgenogram (right) showed progression of the disease with formation of rigid pipe-stem loops with polypoid changes.



Figs. 3 and 4. Case 2: A 14-year-old infantile white boy entered with diarrhea and weight loss. The admission roentgenogram (left) shows evidence of rigid pipe-stem loops in the jejunum and terminal ileum.

Three years later the patient was clinically symptom-free but a roentgenogram (right) showed progression of the disease with extension of the rigid pipe-stem involvement of the jejunum.

Fig. 5. Case 2: Same patient as Figs. 3 and 4, three years later. Clinically there were no signs of ileo-jejunitis. Intestinal obstruction developed due to multiple areas of stenosis and stricture formation.

pattern is fragmented. There is no definite stenosis.

In the chronic phase the jejunum shows great irregularity in outline, with rigidity. The normal feathery mucosal pattern becomes fragmented. The barium sometimes forms what seems like a cast within the lumen, presumably due to the greatly thickened walls. The rigid loops often appear like pipe stems. They are sometimes dilated. Polyposis of the mucosa is usually suggested by the mucosal pattern. Stenosis is a constant feature in our series, extending over long segments. Skip areas usually can be visualized and are characteristic. A serration in outline is sometimes noted in active cases and is taken to indicate the presence of ulceration. The two characteristics, therefore, of the chronic phase are pipe-stem loops and multiple strictures. The terminal ileum is not regularly involved.

There are certain features which were found in our series to be common to all phases. There was no constant change in the motility of the small bowel, as the disease progressed from phase to phase under observation, nor was there any significant change in motility or small bowel pattern during intensive treatment with liver and vitamin B. Atropine administered until dryness of the mouth was obtained did not change the configuration of the small bowel. The disease was not always in the same phase in the various loops. Not infrequently, severe stenosis was noted, both pathologically and radiologically, in one portion of the small bowel while in another there was no stenosis but rather evidence of subacute disease. Progression of the disease was observed roentgenologically, often in the face of clinical improvement. In some cases, although the symptoms had entirely subsided, cicatrization continued, producing stenosed loops.

COURSE OF THE DISEASE

The evidence afforded by this small series of cases is inconclusive, but there appeared to be little statistical difference in prognosis whether the patient was first seen in an acute stage or a chronically active phase. Six of the series were first seen in the acute or subacute phase. In one acute case complete regression of clinical symptoms and at least partial regression of the x-ray changes were obtained. A second became chronic with acute exacerbations; a third continued with low-grade activity. Of the subacute cases, one followed a subacute course for several months, with death after exploratory laparotomy. Another, in which recovery occurred within a short time, has remained inactive. A third entered a chronically active phase and has continued to show low-grade activity for several months.

The cases which were first seen in a chronically active phase numbered 17. Five became chronically inactive. Three patients died following operative procedures for intestinal obstruction. Three continued to show acute exacerbations and 6 low-grade activity.

As already indicated, evidence of mild intestinal insufficiency developed in a few

patients (6 cases). This occurred rarely in the acute phase. The presence of this complication was judged by one or more of the following findings: macrocytic hyperchromic anemia, infantilism, elevated fat content in the stool, diminished blood calcium, and a flat Janney curve.

DISCUSSION

When the roentgen appearance of the jejunum and ileum is abnormal, differentiation between inflammatory and deficiency disease may be difficult, but an acute clinical course, involvement of the terminal ileum, the presence of segments of normal bowel separating diseased areas, stenosis, and serration in outline suggesting ulceration indicate an inflammatory process. An abnormal roentgen pattern in deficiency states (4) often is associated with clinical evidence of avitaminosis, while ileo-jejunitis has few definite signs of intestinal insufficiency. This difference in the clinical picture, in spite of diffuse involvement of the small bowel in both conditions, may be due in some cases to the relatively short duration of the infectious type and in others to the presence of "skip areas" of normal small bowel. As the disease advances into the chronic phase, intestinal insufficiency may supervene, though usually not to a severe degree, and may be relieved in some cases by the administration of anti-anemic or anti-sprue factors. Hence there may be considerable clinical improvement while the roentgen examination continues to suggest progression of the disease.

Differentiation of the condition from an extensive or recurrent and progressive "terminal ileitis" with "skip areas" of normal small bowel is, of necessity, extremely difficult or impossible. Indeed, the disease may be the same. However, the absence of fistulae and abscesses, the extensive involvement of jejunum and ileum, as well as the fact that in a fair proportion of cases the terminal ileum is not involved, suggest a classification distinct from terminal ileitis.

There were a few cases in our series in which a diagnosis could not be established when the patient came under observation, but subsequent elevation of temperature, leukocytosis, or melena, or cicatrization demonstrable roentgenologically, indicated the inflammatory nature of the process.

It is likely that many cases considered in the past to be primary intestinal tuberculosis, usually without adequate proof, belong in this category. Cases such as those described by Meulengracht (6), with severe macrocytic anemia and multiple strictures of the small bowel, resemble closely many of our series in which careful examination of the operative or postmortem specimen failed to reveal tubercle bacilli.

SUMMARY

An analysis of 23 cases of granulomatous jejuno-ileitis is presented from clinical, pathological, and roentgenologic points of view. This disease appears most frequently in late adolescence or early adult life. It is characterized clinically by diarrhea and abdominal pain, although fever appears during the course of the disease in most cases. There is a distinct tendency to chronicity with varying grades of activity. Roentgenologically, differentiation from a deficiency pattern is difficult in the acute phase, but the chronic disease is characterized by rigidity and stenosis, which occasionally gives rise to obstruction.

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Pseudo-Adenomatous Basal-Cell Carcinoma of the Tongue (Salivary Gland Tumor)[1]

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THE SO-CALLED "mixed tumors" of the salivary gland type, although occurring predominantly in the large salivary glands, are not infrequently encountered in other locations. In 1851 a lip tumor with characteristics identical with the usual parotid neoplasm was described by James Paget. Since then, examples of such tumors located in the lacrimal gland (orbit), nasal cavity, accessory sinuses, pharynx, tonsil, larynx, trachea, lip, buccal mucosa, palate, and tongue have been reported (1).

Mixed salivary gland tumors of the tongue are not common. In 1930 Brunschwig (2) collected 10 cases from the literature and added one of his own. Schreiner and Mattick (3), reporting 66 cases of salivary gland tumors, mention one tongue case. Pack and LeFevre (4), discussing the incidence of various neoplasms seen at the Memorial Hospital from 1917 to 1929, tabulate 17 tumors of the palate and the tongue; the number of tongue cases is not given. Eigler (5), Patey (6), Curtis and Razemon (7), Lemaitre, Ardoin, and Lemaitre (8), Florentin and Grimaud (9), Robillard and Chisena (10), each report one case. In an excellent monograph, discussing 254 salivary gland tumors in various locations, Ahlbom (1) cites four tumors of the tongue.

Because of the relative rarity of this tumor of the tongue, the few reports portraying the course over a long period, and certain unusual and interesting clinical features, the following case is considered worthy of record.

CASE REPORT

G. W., a white male, aged 57, was first seen in the Out-patient Department of the University Hospital on June 2, 1927. For two years a mass had been present on the right side of the neck which, on three different occasions, ruptured and discharged a purulent material for two or three days. In addition the patient had noticed lack of appetite, weakness, and some loss of weight. The past history was noncontributory.

Examination revealed a firm mass involving the right side of the base of the tongue. The tumor appeared to be continuous with an enlarged lymph node of the right anterior cervical chain. No ulceration was present at any point on the surface of the tumor. The rest of the physical examination failed to reveal significant findings.

On June 6, 1927, a biopsy specimen was obtained which, however, failed to include any neoplastic tissue; an adequate biopsy was done on Sept. 26 (see below). On June 14, July 5, and again on Oct. 24, small doses of radium by surface application were administered without any effect on the neoplasm. The lesion increased in size; on Oct. 24 it was described as follows: "The right side of the pharynx is almost completely closed by the mass which projects from the posterior surface of the tongue."

On Dec. 1, six 2.5 mc. gold radon seeds were inserted into the tumor for seventy-two hours. A moderately sharp radiation reaction developed but no significant regression of the tumor followed. The lesion was destroyed by electrocoagulation on April 11, 1928. Examination one year later, April 19, 1929, revealed a recurrence about 3 cm. in diameter, without evidence of ulceration. The patient's general condition was excellent and his appetite good; occasionally a burning sensation was experienced in the right side of the tongue. He was asked to return in a few days for implantation of radon seeds but failed to do so.

Seven years later, on Aug. 3, 1936, the patient was again admitted to the University Hospital, with a history of having enjoyed good health until the previous winter. At that time his throat "began to fill up again," with a change in the character of his voice and interference with the act of swallowing. He had not experienced any pain but had lost 20 pounds in weight during the last six months. He had noticed masses in both sides of the neck for several years.

Examination revealed the presence of a large irregular tumor in the base of the tongue extending from the vicinity of the foramen cecum and the base of the right tonsillar fossa nearly to the base of the epiglottis. View of the larynx was obstructed by the tumor. In the upper neck, just below the angles of the mandible, large (5 cm. diameter), hard, fixed masses were present on each side. The rest of the physical examination was essentially negative. A

[1] Accepted for publication in February 1942.

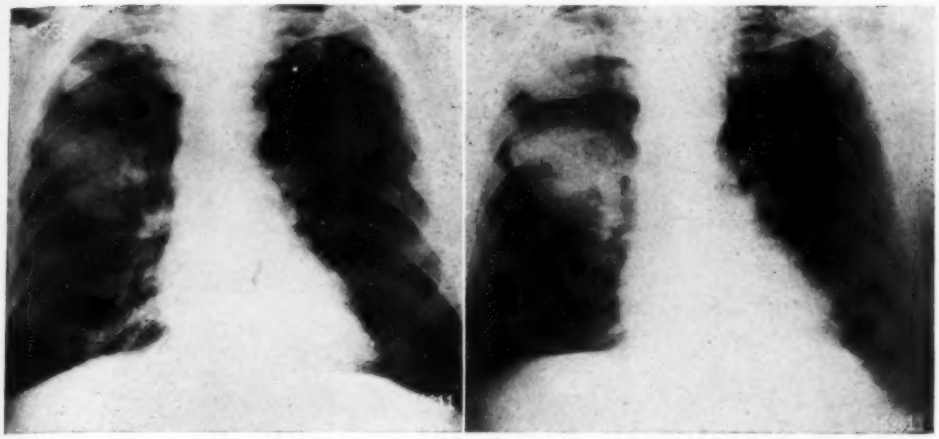

Fig. 1. Aug. 3, 1936. Pulmonary metastases from a pseudo-adenomatous basal-cell carcinoma of the tongue. This roentgenogram was made nine years after initial admission to the University Hospital. No symptoms referable to the pulmonary lesions were present.

Fig. 2. Feb. 16, 1938. Pulmonary metastases from a pseudo-adenomatous basal-cell carcinoma of the tongue. The lesions in the right lung have increased in size; a new lesion is present in the left lung. No symptoms referable to the pulmonary lesions were present.

small piece of the tumor was removed for microscopic examination (see below).

Stereoscopic chest roentgenograms, Aug. 3, 1936, demonstrated the presence of pulmonary metastases. A large lesion (6–7 cm. diameter) occupied the right mid-lung field; above this in the subclavicular area was a smaller deposit; a faintly visible small metastasis (1 cm. diameter) was seen immediately below the largest lesion (Fig. 1).

Because of the advanced pulmonary and cervical metastases, the outlook was considered hopeless. Irradiation of the primary lesion was advised in an endeavor to decrease its bulk and prevent laryngeal and esophageal obstruction. Roentgen therapy was given through right and left neck fields measuring 6 × 8 cm., the beam being centered over the cervical metastases and directed so as to cross-fire the lesion in the base of the tongue. The following physical factors were employed: 200 kv.p. (175 kv. constant potential equivalent), 0.5 mm. Cu and 1.0 mm. Al filtration (H.V.L. 0.9 mm. Cu), 50 cm. skin-target distance, 25 ma., 50 r per minute as measured in air. One field was treated each day with a dose of 200 r, treatment being given alternately to the two fields until each had received a total dose of 2600 r, measured in air. The irradiation was begun on Aug. 10 and completed on Sept. 9. The treatment was well tolerated, only slight radiation sickness being experienced. A moderately sharp mucosal reaction developed in the throat. Some decrease in the obstructive symptoms was noted at the time of completion of therapy.

One month later, Oct. 7, the patient returned for re-examination. He was much improved symptomatically. His voice had resumed its normal character and the dysphagia had diminished materially. He stated that he felt perfectly well and was working daily. The treated skin areas had largely recovered from the radiation reaction. The cervical metastases were about one-half their former size and the primary lesion in the base of the tongue had decreased significantly in bulk. Chest roentgenograms demonstrated no change in the pulmonary metastases; no symptoms referable to these metastases were present.

On Dec. 3, 1936, and April 22, 1937, the patient presented himself for check-up examinations. He continued to feel well; there was no dysphagia or respiratory difficulty. Examination now showed the cervical metastases to be greatly reduced in size, being represented by small soft swellings. The tumor in the base of the tongue had regressed until it was about half its former size. The pulmonary metastases, as seen on check-up roentgenograms, remained unchanged.

Chest roentgenograms made on Feb. 16, 1938, approximately eighteen months after the beginning of the roentgen therapy, showed the metastases in the right lung to have increased in size; a new lesion was present in the left lung (Fig. 2). Symptoms referable to these lesions were still absent. The lesion in the tongue had not changed; in the upper right neck a poorly defined swelling was present; the left neck was free of palpable neoplasm.

A course of roentgen therapy was administered to the chest beginning on March 9 and ending on March 22. The physical factors employed were the same as before. Two fields measuring 20 × 15 cm. were laid out on the anterior surface of the chest; two similar fields were used posteriorly. One field was

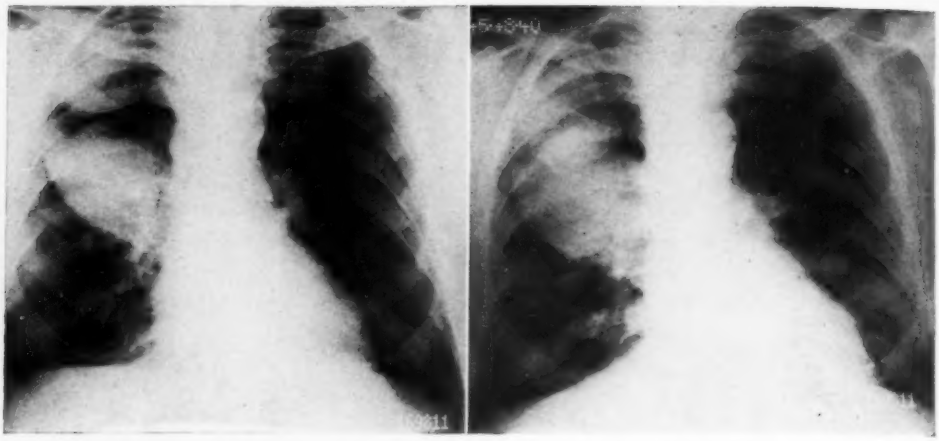

Fig. 3. June 24, 1938. Pulmonary metastases from a pseudo-adenomatous basal-cell carcinoma of the tongue. Slight reduction in the size of the pulmonary lesions following roentgen therapy of low dosage (see text) to both lung fields in March 1938. No symptoms referable to the pulmonary lesions were present.

Fig. 4. May 8, 1940. Pulmonary metastases from a pseudo-adenomatous basal-cell carcinoma of the tongue. Increase in size and number of metastases, as compared with Fig. 3. This roentgenogram was made thirteen years after initial admission to the University Hospital. No symptoms referable to the pulmonary lesions were present.

treated each day with a dose of 300 r, measured in air, rotating through the four fields until each field had received a total dose of 900 r.

Three months later, June 24, 1938, clinical examination failed to reveal any evidence of recurrence in the neck; the primary lesion in the tongue had not increased in size. Chest roentgenograms showed very slight decrease in the size of the pulmonary metastases (Fig. 3). Symptoms referable to these metastases were still absent.

The patient did not return for almost two years. He was admitted to the hospital on May 6, 1940, with the history of having felt perfectly well until the first of February 1940, when pain developed in the right leg on walking or weight-bearing. This persisted and increased in severity to such a degree that codeine, and at times morphine, was used. More recently the pain was also present while the patient was at rest. During the same period he had experienced pain during bowel movements and a sense of fullness of the abdomen, as well as moderate constipation. No dysphagia was present, although there was a sense of slight fullness in the throat.

Examination failed to reveal any cervical metastases, but the tumor in the base of the tongue was still present, apparently not larger than in 1938. There was, however, obvious anterior extension of the lesion beneath the tongue on the right side into the floor of the mouth. Otherwise the physical examination was negative except for the right lower extremity: the patient walked with a decided limp and pain was produced by motion of the right hip in any direction.

Chest roentgenograms, May 8, showed the pulmonary metastases to be increased in size and number as compared with the films of 1938 (Fig. 4). Roentgenograms of the spine were negative but those of the pelvis and femora revealed destructive metastases in the upper portion of the right femur. The greatest destruction was present in the vicinity of the lesser trochanter (Fig. 5).

Roentgen therapy was administered to the lesions in the right femur in an endeavor to diminish pain. With the same physical factors as formerly, 600 r, measured in air, were delivered through each of three 15 × 15-cm. fields; one field was treated with the full dose each day. Treatment began on May 13 and ended on May 15. Following this the patient was discharged to the care of his home physician.

The last information available on this patient is from a letter dated Sept. 30, 1940, in which he stated that the pain in the right leg had disappeared and that he was feeling well; this was thirteen years and three months after his initial admission to the University Hospital and four years following the discovery of the pulmonary metastases.

Histologic Diagnosis: As stated above, the first biopsy, June 2, 1927, failed to include any of the neoplastic tissue. Tissue removed from the lesion of the tongue on Sept. 26, 1927, was described as follows by Dr. A. S. Warthin: "Adenocarcinoma mucosum, arising in a salivary gland mixed tumor. It is infiltrating the muscles of the tongue but probably is very much less malignant than the squamous-cell carcinoma of the tongue. If the lesion appears to be sharply circumscribed, I would advise local excision only, with a good surrounding border of tissue" (Fig. 6).

The report on the next biopsy (Fig. 7), Aug. 3, 1936, was as follows: "Medullary carcinoma of the type tentatively designated by us as 'pseudo-adenomatous basal-cell carcinoma', apparently arising in a mixed salivary gland tumor. In small portions submitted the neoplasm has much the same structure as when examined by us in September 1927. At that time it was called adenocarcinoma mucosum. In general we feel that the term given above is to be preferred since these neoplasms form a group characterized by low-grade malignancy and intimate association with salivary gland tumors."—J. C. Bugher, M.D.

DISCUSSION

The complex structure of the mixed tumors of the salivary glands early precipitated an extended controversy over the nature of their origin. At the present time the weight of opinion appears to favor an epithelial origin, although the exact mode of histogenesis has not been clearly delineated. According to Ewing (11), "no single source of the mixed tumors meets all the requirements." The epithelial elements may assume a variety of forms; cartilaginous, myxomatous, and cellular connective tissues constitute the second characteristic feature of these tumors.

One fairly characteristic variety of these tumors is found in the case reported here. Tubular or cord structures made up of cuboidal epithelial cells identical with the cells of basal-cell carcinoma are the most striking feature. As with other types of salivary gland tumors, these neoplasms have been variously designated: adenoid cystic epithelioma, adenocystic carcinoma, adenocarcinoma mucosum, basal-cell carcinoma with cylindromatous formation, cylindromatous epithelioma, and cylindroma.

Of the 10 cases collected from the literature by Brunschwig (2), 4 were termed "cylindroma" and 1 "adenocarcinoma"; these very probably are of the same character as the case reported here. Brunschwig's own case, called a "mixed tumor," showed a predominantly papillary cystic structure and appears to be a different variety of neoplasm. Three of the 4 cases described by Ahlbom (1) were designated as "basal-cell cancer type with cylindromatous areas." The cases tabulated by Pack and LeFevre (4) were termed "adenoid cystic epithelioma." Eigler (5) described his case as an "epithelioma zylindromatosum," while Lemaitre, Ardoin, and Lemaitre (8) and Florentin and Grimaud (9) used the non-specific term "cylindroma." Curtis and Razemon (7) diagnosed their case as "adénome glandulaire baso-cellulaire." No specific histologic diagnoses were given by Schreiner and Mattick (3) or by Patey (6). The lesion reported by Robillard and Chisena (10) was called simply a "mixed tumor," but from the description does not appear to be of the type under discussion. It is evident that the majority of the salivary gland tumors ocurring in the tongue are of the type encountered in our case.

It has been pointed out by various authors, Ahlbom (1), Stein and Geschickter (12), and others, that the malignant tumors of the salivary gland type exhibit a relatively low level of clinical malignancy compared to other malignant neoplasms. They tend to grow slowly and to metasta-

Fig. 5. May 8, 1940. Metastases in the upper portion of the right femur from a pseudo-adenomatous basal-cell carcinoma of the tongue. The symptoms of pain in the right hip and limp on walking disappeared following roentgen therapy (see text).

size late. Of the entire group of malignant salivary gland tumors, the pseudo-adenomatous basal-cell carcinomas (basal-cell cancer type with cylindromatous changes) are considered by Ahlbom to be the least malignant.

Of the 17 cases (including the one reported here) of salivary gland tumors of any type in the tongue, in which data on sex and age are available, it is found that 6 occurred in males and 11 in females. One patient was sixteen years of age when the neoplasm was discovered, 7 were in the third to the fifth decades and 9 in the sixth to the eighth decades. In the cases in which the neoplasm was of the pseudo-adenomatous basal-cell carcinoma type, the sex and age distribution was similar.

The salivary gland tumor of the tongue is characteristically located in the base of the organ. Only a few cases are described in which the tumor occurred in the anterior portion near the tip, or along the margin. Only one of the tumors situated at a site other than the base of the tongue was of the pseudo-adenomatous basal-cell cancer type.

The gross morphology of these tumors of the base of the tongue is exemplified by the appearance of the lesion in our case. The tumor appears usually to be rather circumscribed, as if encapsulated, and is located submucosally. The overlying mucosa is intact; ulceration is a late manifestation. In the case reported the mucosa remained intact throughout the period of observation.

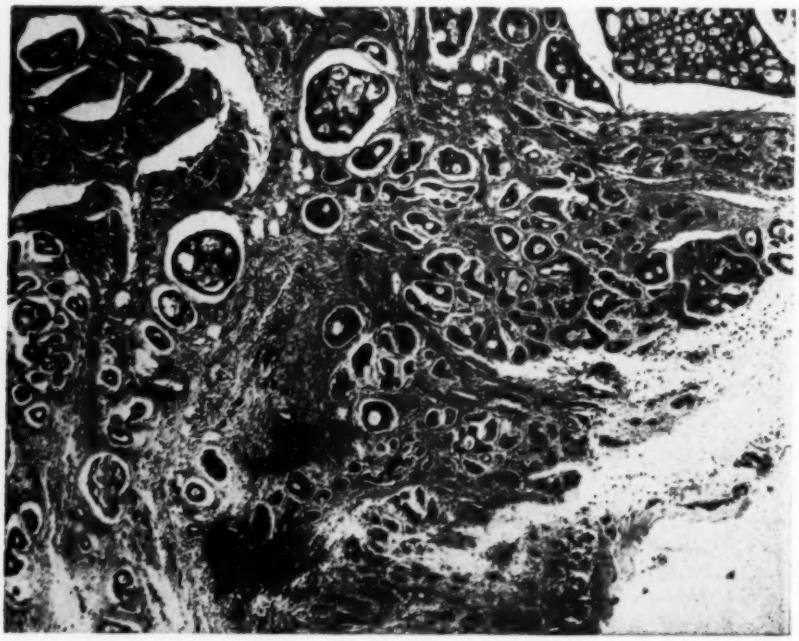

Fig. 6. Sept. 26, 1927. Pseudo-adenomatous basal-cell carcinoma of the tongue arising in a mixed salivary gland tumor. Photomicrograph of tissue obtained at the initial biopsy, diagnosed as "adenocarcinoma mucosum arising in a salivary gland mixed tumor."

The symptoms presented by our patient on admission to the hospital in 1936, change in the character of the voice and difficulty in swallowing, were obviously due to mechanical interference by the mass projecting from the surface of the base of the tongue. In the cases reported in the literature these symptoms are characteristically found if the tumor is sufficiently

large. Some patients have complained of other symptoms, such as soreness in the tongue or pain in the throat. On the initial admission our patient gave a history of an abscess forming in the upper right neck which discharged purulent material on several occasions. It is of interest that one of Ahlbom's (1) cases (Case 225) gave a similar history of abscess formation in the throat.

Metastases from malignant salivary gland tumors are not uncommon. Twenty per cent of the 82 malignant lesions described by Ahlbom (1) presented clinical evidence of lymph node metastases when first seen. He estimates that over the entire course of the disease about 50 per cent of the cases show such metastases. Numerous examples of pulmonary metastases are to be found in the literature: Ahlbom (1), Benedict and Meigs (13), Kornblith (14), Smith (15), MacFee (16), Olson (17), and others. A frequent statement made in the literature is that metastases in the lungs are more common than is generally recognized.

The data concerning metastases from the pseudo-adenomatous basal-cell carcinoma of the tongue are meager. One of Ahlbom's cases (Case 223) (1) presented clinical evidence of abdominal metastases just before death; no lymph node metastases in the neck were detectable. The case of Ewald, cited by Brunschwig (2), presented metastases in the pharynx, the floor of the mouth, and the cervical lymph nodes at the time of the second recurrence of the tumor. The other reports do not describe metastases; the majority were published immediately after surgical removal of the tumor and emphasize the histopathology of the lesion. These tumors of the tongue probably behave like the pseudo-adenomatous basal-cell carcinomas at other sites, such as the parotid gland, the sublingual gland, etc. Con-

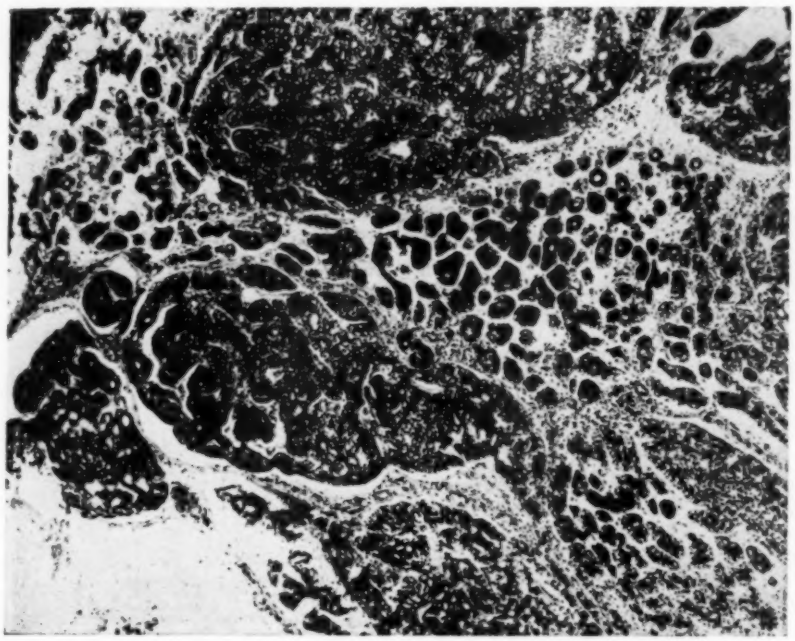

Fig. 7. Aug. 3, 1936. Pseudo-adenomatous basal-cell carcinoma of the tongue arising in a mixed salivary gland tumor. Photomicrograph of tissue obtained at the second biopsy, performed approximately nine years after the initial biopsy (see Fig. 6).

sidering their low grade of clinical malignancy, they tend to metastasize frequently (1, 2, 14, 15).

The course of the disease in the case reported here presents several features of interest. The slow growth, over a period of seven years, of the recurrence demonstrated in 1929 is not unusual for a salivary gland tumor of definite malignant character. At the end of this seven-year period, nine years after the patient was first seen, large cervical metastases were present. Exact information as to the time of initial appearance of these metastases is not available; the patient stated that they had been present for several years prior to his admission in 1936. Compared with other malignant lesions of the oropharynx, the cervical metastases may be considered to have developed relatively late, which is in keeping with the general character of this type of neoplasm. The metastases must be considered to have grown very slowly over the period of several years during which they were known to exist. Not only the primary lesion but the cervical metastases as well exhibited a slow rate of growth.

The sluggishness of tumor growth in this patient is strikingly revealed by the behavior of the pulmonary metastases. When first discovered in August 1936, the lesions in the right lung were large (Fig. 1). Further increase in size took place slowly but was demonstrable in the films of February 1938 (Fig. 2), eighteen months later. In view of the increment in volume developing over this period of eighteen months, it is evident that the metastases must have been in existence for several years prior to the examination of August 1936. At no time, from the discovery of the pulmonary lesions until the patient was last heard from in September 1940, did he present any symptoms referable to these lesions. The metastases were demonstrated roentgenographically over a period of four years; one may assume with assurance that they had been in existence for a minimum period of two or three years prior to discovery.

The presence of pulmonary metastases is generally considered to be a terminal manifestation of the disease, the period of survival after the demonstration of such lesions being short. The present case is a notable exception to this conception, and constitutes an excellent example of what Ahlbom (1) terms "the sedate course" of the metastases. The question may be raised regarding the influence of the roentgen therapy to the chest on the growth rate of the pulmonary lesions. Films made three months after the treatment revealed only minimal reduction in size, and in the next two years the rate of growth was more rapid than in the eighteen months preceding irradiation, as can be seen by comparing the change in size of the lesions in Figures 1 and 2 with that in Figures 3 and 4. The effect of the small dose of roentgen rays administered to the lung fields clearly was not significant.

Metastases to bone from malignant salivary gland tumors is mentioned only infrequently in the literature; Benedict and Meigs (13) report one case, Ahlbom (1) observed bone lesions in two cases. None of the reported tongue cases presented osseous metastases.

The reaction of the neoplasm in the case reported here to roentgen therapy is of interest. The initial radium treatments produced no significant effect; this was obviously due to the inadequacy of the dosage employed. By means of fractional roentgen therapy, as described above, with dosage of moderate intensity (2600 r, measured in air, to each of two fields over a period of one month), considerable diminution of the volume of the primary lesion was obtained; the large cervical metastases in each side of the neck were made to disappear completely without evidence of recurrence three years and nine months after the beginning of the course of irradiation. The neoplasm in this patient may be definitely classified as radioresponsive. Ahlbom (1) places his tumors of similar histology in the class of radiosensitive malignant salivary gland tumors.

SUMMARY

A case of pseudo-adenomatous basal-cell carcinoma (basal-cell cancer with cylindromatous areas or adenoid cystic epithelioma) of the base of the tongue arising in a mixed salivary gland tumor is reported. A review of the literature shows this to be a relatively rare tumor of the tongue. The patient was observed over a period of thirteen years, during which time cervical, pulmonary, and osseous metastases developed. Roentgen therapy reduced the bulk of the primary lesion and caused the cervical metastases to disappear. The pulmonary metastases, observed over a period of four years, showed a very sluggish rate of growth and produced no symptoms; it is estimated that these lesions had been in existence for at least two or three years prior to discovery. Roentgen therapy abolished the pain due to the osseous metastases. When last heard from, thirteen years and three months after the first admission to the hospital, the patient was asymptomatic despite the presence of tumor in the tongue, the floor of the mouth, the lungs, and the right femur.

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Calcified Cystic Tumor of the Spleen[1]

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NON-PARASITIC cysts of the spleen are rarely encountered and present a diagnostic problem interesting enough to make the report of such a case justifiable. In a comprehensive review of the world literature up to January 1939, Fowler found only 137 examples of non-parasitic splenic cysts. In 800 splenectomies performed at the Mayo Clinic from 1904 to 1934, only 4 cysts of the spleen were found, an incidence of 0.5 per cent.

REPORT OF CASE

History: A white female, single, aged 25, was admitted Nov. 5, 1940, for possible appendectomy. On Nov. 2, 1940, she had experienced pain in the right side of the abdomen and about the umbilicus, which gradually became localized in the right lower quadrant. There were no associated gastro-intestinal symptoms. During the functional inquiry by the admitting house physician, it was learned, quite incidentally, that about two years previously the patient had noticed a good-sized mass in the left upper abdomen. It had not changed in size since that time and had caused no pain, discomfort, or other symptoms. There was no history of malaria, syphilis, pregnancy, or significant trauma.

Physical Examination: There was a large bulging area on the left lower chest anteriorly and laterally, which extended down into the abdomen to the level of the umbilicus. In the abdomen the mass was soft and somewhat fluctuant. It was dull to percussion, non-tender, and moved with respiration. Over the chest in the region of the bulge there were dullness and absence of voice and breath sounds. Slight tenderness in the right lower quadrant of the abdomen was elicited.

Laboratory Findings: Urinary findings were normal. The red blood cell count was 5,000,000; hemoglobin 97 per cent; white cells 6,400, with a normal differential count. Blood glucose, urea nitrogen, carbon dioxide combining power, and sodium chloride were normal. The Wassermann test was negative.

X-Ray Findings (Nov. 5, 1940): A flat film of the abdomen taken with the patient in the prone position showed an elevation of the left half of the diaphragm, the dome being at the level of the lower border of the body of the eighth dorsal vertebra. The dome of the right half of the diaphragm was at the level of the upper border of the tenth dorsal vertebra. There was some bulging of the left lower thoracic cage with widening of the interspaces between the ribs. In the left upper abdomen was a well circumscribed area of density extending from the diaphragm down to the level of the upper border of the body of the third lumbar vertebra and from the left lateral abdominal wall to about the midline. The lower border of this shadow was rounded and there was considerable calcification in this area. There was one oval area of mottled calcification within the mass, overlying the left transverse process of the first lumbar vertebra. In the lateral projection, the mass in the left upper quadrant was seen to extend from the anterior abdominal wall to about the anterior border of the bodies of the lumbar vertebrae posteriorly. The area of oval calcification previously mentioned lay about one inch anterior to the vertebral bodies.

Study of the upper gastro-intestinal tract with barium showed the esophagus to be within normal limits. The elevated half of the diaphragm moved well with respiration, and with motion of the diaphragm the mass in the left upper quadrant also moved. The stomach was displaced posteriorly and downward by the mass, which produced a smooth arc-like indentation along the anterior gastric wall, apparent in the lateral projection, causing considerable narrowing of the lumen. Intrinsically the stomach was normal.

At the end of five hours the head of the barium meal was at the splenic flexure, which was pushed low in the abdomen by the left upper quadrant mass. The splenic flexure was at the level of the transverse process of the third lumbar vertebra.

X-Ray Interpretation: "Large solitary cystic tumor in the left upper abdomen with calcification in the inferior wall. The tumor arises superiorly and anteriorly to the stomach, forcing it downward and backward. The origin of the tumor is probably within the spleen."

Operative Findings (Nov. 8, 1940): Through a

[1] Accepted for publication in March 1942.

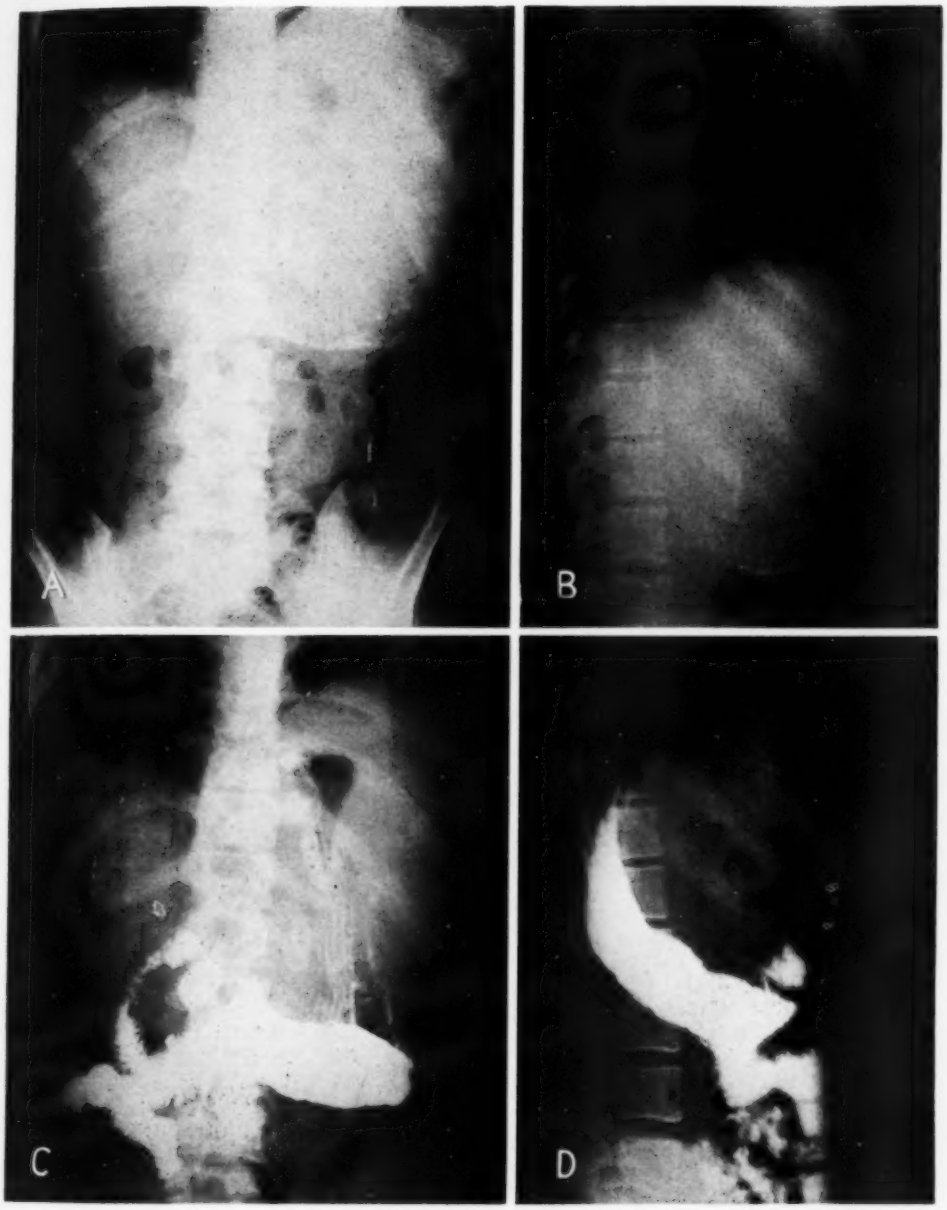

Fig. 1. A. Postero-anterior roentgenogram of abdomen showing mass in left upper abdomen with calcification in its lower border. Elevation of the left hemidiaphragm is also shown.
B. Left lateral projection, which shows further relationships of tumor seen in A.
C. Postero-anterior view showing gastric displacement by tumor.
D. Lateral projection which shows the stomach displaced posteriorly.

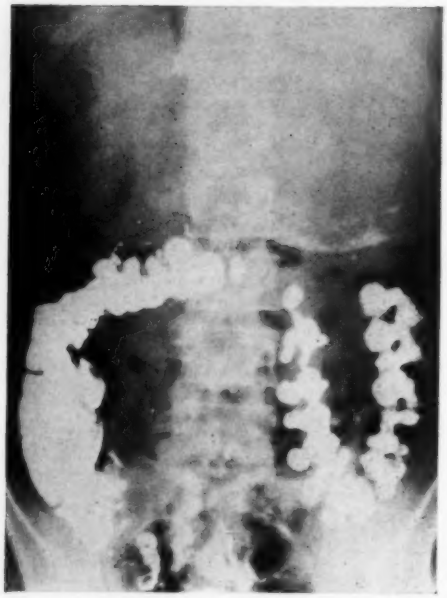

Fig. 2. Five-hour film, showing downward displacement of the splenic flexure.

muscle-splitting right lower quadrant gridiron incision the appendix was delivered and removed. The wound was closed in the usual fashion. A left rectus incision was then made, exposing a large cystic tumor of the spleen, which completely filled the upper left quadrant from a point three inches below the costal margin to the dome of the diaphragm. The fluid contents were partly aspirated, the spleen with the cyst was removed, and the wound was closed.

Pathologic Findings: The spleen measured 10 × 4.5 × about 1.5 cm., with a huge cyst arising from the anterior border, and also in part from the superior half of the gastric surface. The total weight of the specimen, excluding that portion of the fluid content aspirated during operation, was 1,240 gm. The cyst measured 22 × 15 × 10 cm.

The capsule over the anterior and superior half of the cyst was distinctly thickened, of grayish white color, and of firm, fibrous, almost cartilaginous consistency. On cut section, the cyst was found to be partially filled with a pale bluish red fluid of rather soup-like consistency. The cyst cavity was, in the true sense, multiloculated, being composed of one huge main chamber, about 15 cm. in diameter, forming the bulk of the tumor, and a second chamber, about the size of a plum, situated at the junction of the tumor and spleen. In addition, there were a few small cysts, averaging 1.0 to 1.5 cm. in diameter, within the wall of the tumor itself at its point of origin from the remnants of the spleen. For the most part, the cyst wall was approximately 3 to 4 mm. in thickness; near its origin in the spleen, however, the wall reached a thickness of 1.5 cm. Its lining surface was smooth and covered, especially at its dome, with an adherent, light chocolate brown material, in places somewhat shaggy, apparently organizing older blood. Here and there, within the wall, distinct focal calcification was palpable.

Several sections were taken through the cyst wall. Microscopically it was composed of fibrous tissue, showing marked hyalinization, a few scattered capillary blood vessels, and many cholesterol crystal spaces with surrounding foreign-body giant cells. The lining epithelium was to a great extent deficient. Where preserved, it was of endothelial type, showing, in many fields, distinct flattening. Where the epithelium was deficient, the lining surface showed, in various areas, lipoid resorption granulations with focal calcification, or adherent thrombosed material undergoing regressive changes with considerable calcium encrustation and huge areas of calcification. In one section there were several small daughter cysts with endothelial lining.

Fig. 3. Operative specimen. The upper photograph is of the intact specimen, medial aspect, showing the cyst arising from the anterosuperior border of the spleen. In the lower photograph a portion of the cyst wall has been removed, showing the main cyst cavity and its lining surface with adherent detritus. Several intramural daughter cysts also are shown. In this view the hilus of the spleen and its relation to the cyst are well demonstrated.

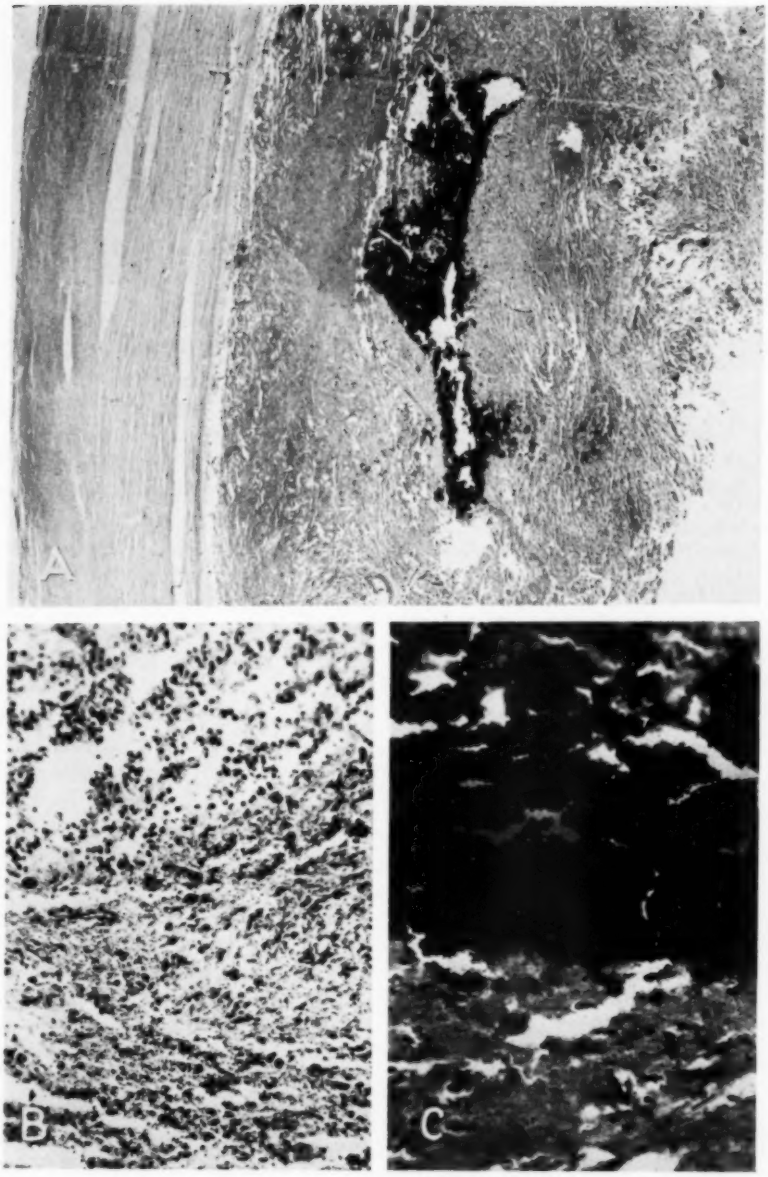

Fig. 4. A. Low-power photomicrograph of section taken through entire cyst wall, showing hyalinization of the wall and detritus adherent to the lining surface. Within the detritus a large area of focal calcification and more diffuse minute calcium encrustations are seen.
B. Area of diffuse calcium encrustation (higher magnification).
C. Edge of the area of focal calcification (higher magnification).

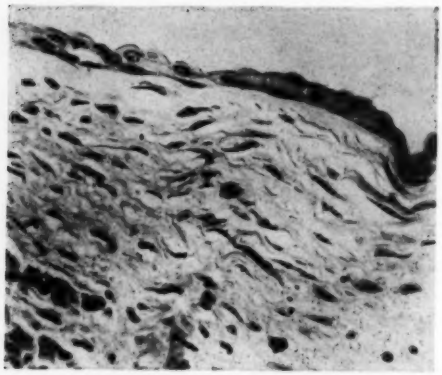

Fig. 5. High-power photomicrograph of section taken through cyst wall, showing an area of preserved simple squamous lining epithelium.

The immediately adjacent splenic pulp showed distinct compression with markedly atrophic malpighian follicles, hyalinization of arteries, and fibrosis of reticulum.

Diagnosis: Cystic angioma of the spleen.

Course: The postoperative course was uneventful and the patient was discharged on Nov. 21, 1940, with her wound healed and her general condition excellent.

DISCUSSION

Various classifications of cysts of the spleen are found in the literature, based for the most part on the character of the contents, cell lining, or morphology. Thus, they have been classified as true or false, depending upon the presence or absence of a lining epithelium; and as hemorrhagic, serous, or lymphatic, depending on the type of their contents. From a purely morphological point of view, cystic disease of the spleen is of four types: (1) a large solitary cyst (usually with hemorrhagic contents); (2) numerous small subcapsular or capsular cysts; (3) so-called multiple cystic or polycystic spleen (entire parenchyma studded with cysts of various sizes); (4) one large cyst with several small satellite daughter cysts, the entire complex involving only part of the splenic parenchyma, which is otherwise well preserved.

Fowler offers a more satisfactory classification, based on the pathogenesis. He divides all cysts of the spleen into two main groups: primary and secondary. Primary cysts are usually genuine or true cysts, while secondary cysts are false cysts. He further subdivides these two main groups as follows:

A. Primary cysts.
   1. Congenital
   2. Traumatic
   3. Inflammatory
   4. Neoplastic
   5. Parasitic

B. Secondary cysts.
   1. Traumatic
   2. Degenerative
   3. Inflammatory

Congenital, traumatic, and inflammatory primary cysts are, in turn, subclassified according to their more intimate mode of origin as: (*a*) infolliation cysts, which are usually small multiple or isolated surface or subcapsular cysts originating consequent to abnormal invagination of the perisplenium during the development of the organ, or following infolliation of peritoneal endothelium after small traumatic rupture of the splenic capsule; (*b*) dilation, or ectatic cysts, including lymphangiectasis and polycystic disease.

Neoplastic primary cysts include dermoids, epidermoids, lymphangiomata, and cavernous angiomata. The only parasitic cyst is the ecchinococcal cyst.

Concerning the incidence of these various types, Fowler found, in his review of the literature, that ecchinococcus cysts occur about twice as often as non-parasitic cysts, and that of the non-parasitic cysts, secondary cysts are four times as common as primary cysts. Of the non-parasitic cysts 21 per cent were primary and 79 per cent were secondary. Polycystic disease, lymphangioma, and angioma account for 13 of the 21 per cent of primary cysts, the remaining 8 per cent being dermoids and epidermoids. On the other hand, large solitary hemorrhagic cysts accounted for 71 per cent of the secondary variety, the remaining 29 per cent being of the large solitary serous type, occasionally associated with multiple small cysts.

In 18 per cent of Fowler's cases there was a history of previous splenomegaly attributable to antecedent malaria, syphi-

lis, typhoid, paratyphoid, or mumps. In 23 per cent of the cases there was a history of trauma. Calcification within the cyst wall was found in 9 per cent of the series. Sixty per cent of his 137 cases occurred in females.

In 1937 Shawan reported a case of an extensively calcified splenic cyst, and at that time outlined the various types of calcium deposits noted in the spleen, as follows:

1. Small scattered deposits which are thought to be the result of infection (such as tuberculosis or ecchinococcus) or trauma, followed by calcification during the process of healing. These also may be phleboliths.
2. Large calcified tumors.
3. Atheromatous arteries, demonstrable roentgenographically.
4. Calcified cysts of the spleen.

According to Shawan the exact nature and method of deposition of calcium in the spleen are unknown.

The symptomatology of splenic cysts is vague. Often tumor is the first symptom noticed by the patient. A sense of fullness or a dragging sensation may occur, and there may be pain in the left thorax or left upper abdomen. Dyspnea, palpitation, and gastro-intestinal symptoms may occur when the tumor has reached sufficient magnitude.

On physical examination the most startling observation is the presence of the tumor in the left upper abdomen. Frequently this extends to the right of the mid-line. Actual deformity of the left chest wall may be noted. Fluctuation in the mass may give a clue to its cystic nature. The position of the cyst is usually more superficial than one would expect if the lesion were in the kidney or pancreas. Careful blood studies should always be made to rule out blood dyscrasias.

The roentgenologic study of this lesion is of particular interest, as this offers, we believe, the most accurate diagnostic aid. In 1931 Butler and Ritvo published a paper on changes in the gastro-intestinal tract resulting from extra-bowel pathology. We feel that it would be of value at this time to summarize some of their observations, particularly in regard to tumors of the upper left abdomen.

Tumors of the left upper quadrant may have any one of the following origins—spleen, left kidney, splenic flexure, stomach, left lobe of the liver, and tail of the pancreas. Barium studies of the gastro-intestinal tract are of extreme value in locating extra-bowel pathology. Splenic enlargement characteristically causes a smooth indentation anteriorly on the greater curvature of the stomach in the region of the cardia and media, and as the enlargement becomes more marked, the stomach is displaced downward and to the right. The splenic flexure, also, is pushed downward and to the right. Tumors of the left kidney must be quite large in order to cause deformity of the gastro-intestinal tract. The enlargement in the instance of lesions of the left kidney is posterior to the stomach, so that deformity is in the nature of a compression from behind, and the stomach is displaced toward the mid-line; the transverse colon is displaced downward, and the splenic flexure may be pushed to the left and compressed against the lateral abdominal wall. Tumors of the left lobe of the liver may displace the stomach and splenic flexure downward and to the left, according to the degree and type of enlargement. Tumors of the tail and body of the pancreas usually cause deformities of the greater curvature and lower portion of the stomach. The defect in this instance usually is rounded and smooth in outline and changes as the position of the patient is changed. The posterior gastric wall may be forced anteriorly, and the tumor may extend into the lesser peritoneal sac, causing a flattening of the lesser curvature side of the stomach. The distal third of the transverse colon also may be displaced downward and to the left. In the case of tumors of the stomach and of the splenic flexure, studies of the colon and stomach with the aid of barium serve to establish the diagnosis.

Roentgenoscopy combined with palpa-

tion is extremely important to determine mobility and the presence or absence of adhesions to other organs, and also to indicate whether or not the mass moves with respiration.

In 1937 Ostro and Makover reported a case of non-parasitic cyst of the spleen in a thirteen-year-old girl with full clinical and roentgen studies, followed by surgical removal of the spleen. In their roentgen studies, they found displacement of the stomach and lower third of the esophagus to the right, displacement of the splenic flexure downward, elevation of the left diaphragm, and spreading of the lower left rib interspaces.

We have presented our case of calcified angiomatous cyst of the spleen for two reasons; first, because of the rarity of the lesion from a pathologic standpoint, and second, because of the clear-cut diagnostic roentgen findings. We feel that it is important to re-emphasize the value of barium studies of the gastro-intestinal tract in determining the presence and site of pathology outside the gastro-intestinal tract.

CONCLUSIONS

1. A case of cystic angioma of the spleen is presented, showing calcification in the wall.

2. Splenic cysts are rare, symptoms are vague or absent, and the most striking clinical finding is a mass in the upper left abdomen.

3. Roentgenologic studies of the gastro-intestinal tract with barium are an accurate aid in the diagnosis of splenic tumors and of other extra-gastro-intestinal pathology.

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The Present Status of Roentgen Therapy in Chronic Paranasal Sinusitis[1]

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IT IS WITH SOME reluctance that we undertake to discuss the subject of roentgen therapy in chronic sinusitis, not on account of any disappointment in the results obtained but because we have previously reported our clinical and experimental work (1–3) and also because the field has been so well covered by many competent observers (4–14). We have no new material to present but hope to correlate our experience with that of others.

Our first series, consisting of 100 cases, began in 1929 (1). Upon completion of that series our results were presented before a group of rhinologists. Much skepticism was expressed and there were many dire predictions as to the futility of such an attempt at therapy and the harmful results that would surely come to the patient. We were also led to believe that some seriously doubted the accuracy of our statistics as to symptom-free, improved, and unimproved cases. We did not secure the support of the rhinologists as a group, as we had hoped to do.

With this glimpse into the background, it can be appreciated that it has been heartening to us not only to find that the work of others has proved x-ray therapy of sinusitis to be sound but also to see that their statistical results are very close to ours. We reported, for instance, in 1934 upon 450 cases of chronic sinusitis, our statistics showing 36 per cent of our patients symptom-free and 55 per cent improved after roentgen therapy (2). In 1939, Firor and Waters (4) of Baltimore published their percentages of 34 per cent symptom-free and 51 per cent improved. Hodges (5) of Richmond reported 30 per cent symptom-free or markedly improved. Rathbone (6) of Washington, D. C., working with children, reports 57 per cent in the same classification. These results are of further interest when one realizes that the technic employed is not exactly the same in any two of these groups; each operator applies the roentgen beam in such fashion as he believes to be the most effective. The number of sittings required to complete the adequate dose also varies from the massive dose, all given at one time, to the fractional dose divided among three or four visits. The uniformly good results obtained despite the wide variations in technic are further proof that the x-ray is a useful adjunct in the attack upon chronic sinusitis.

In our experience, covering eleven years we have yet to see a harmful result and we have been unable to learn of any. The prediction that roentgen therapy would stimulate fibrosis to such a degree as to make surgical removal of the membrane impossible has been proved false. We have had the opportunity to check up on six of our patients who were operated upon following failure to obtain cure by irradiation, and in no instance did the surgeon encounter any difficulty in the removal of the thickened membrane. Gatewood makes similar comment concerning four like cases (7). It has been our privilege to observe a considerable number of our early patients throughout the entire time in which we have been using roentgen therapy. These patients cover age groups from childhood to late adult life, and we have seen no evidence of harmful effects from the rays.

During the last few years, we have noticed a change in the attitude of some rhinologists toward roentgen therapy; but these are too few when one contemplates the number of patients who are still going to surgery without the opportunity of trying

[1] Read before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

roentgen therapy. This situation is particularly regrettable in view of the fact that radical surgery is not without danger and still has its percentage of failures. X-ray therapy, when successful, is rather inexpensive; when a failure, it is markedly less a gamble than a poor surgical result, especially when viewed in the light of hospitalization, discomfort, and loss of time.

The lack of co-operation between the rhinologist and the radiologist has been deplored by the majority of those who have written on the subject. The rhinologists as a group have been most reluctant to accept roentgen therapy as a useful adjunct in the treatment of sinusitis, a reluctance no doubt based upon their lack of confidence in the knowledge possessed by the radiologist where sinus disease is concerned. The radiologist has frequently been taken to task for reporting patients cured or relieved without a thorough rhinological examination before and after treatment. We are willing to admit that such procedure is highly desirable when it can be carried out, but in our experience this represents an impossible routine to establish, chiefly because a majority of our patients have already failed to obtain relief from rhinological treatment and refuse to accept further procedure along that line. Another cause lies with the rhinologists themselves, many of whom refuse to permit their patients a trial of roentgen therapy and even condemn it as a harmful agent. We are happy to say that a few are using it in some of their cases and that some others are now working with radiologists in an effort to determine the true value of irradiation.

We have been severely criticized for relying upon clinical and roentgenological findings for diagnosis in so many of our cases, but we are firmly convinced that we are justified in carrying on as at present when we consider the number of patients who have experienced complete relief following roentgen therapy after having suffered from sinusitis for many years. We do not treat every patient who comes complaining of what he believes to be sinusitis, and no doubt we have refused to treat some who had the disease but whose clinical and radiographic findings were not convincing. We do not hold that roentgen therapy is the answer to the sinus problem, but we are firmly convinced that it has made possible a large number of recoveries without surgical intervention.

We have found no reason to change our original classification of the various types of sinusitis based upon their usual response to roentgen therapy (2). Purely allergic sinusitis has not responded, although we have tried varying technics. Allergic sinusitis with secondary infection has been helped. Polypi and cysts have not been favorably affected in our series of patients, and others have reported similar experience. Rich (8) has recorded two cases in which favorable results were obtained by combined rhinological and roentgen therapy and expects to publish a larger series at a later date. Robinson (9) has reported some results in polypi following the use of radium. We have been successful in preventing recurrence of nasal polyps after excision, by reducing the infected swollen membrane by x-ray. Atrophic sinusitis has responded in a few cases to repeated light doses. Chronic fibrosis has not been generally alleviated, although many patients have been materially relieved, because of the destruction of small areas of infected membrane intermixed with the scar tissue. Our most consistent failures are with patients who have undergone radical surgery without relief.

It appears to be the general experience of all observers that the best results are obtained in those patients suffering from chronic infection of the sinus membranes where roentgenograms reveal a markedly thickened membrane with a small central pneumatized cavity. It is with this group that we have had our highest percentage of good results. It also appears to be the general experience that secondary symptoms, such as headache, neuritis, bronchitis, etc., that have their primary focus in the sinuses, are readily relieved, although the sinuses may not have returned entirely to normal.

The question of permanence of relief frequently comes up in the discussion of x-ray therapy. Recurrences are seen, but these are not as frequent as might be expected. The most perfect result that could be obtained would be the restoration of the sinuses to their normal state. Normal sinuses become infected; why then need we be chagrined if a treated sinus again becomes infected at a later date? We have observed that reinfection following roentgen therapy is the exception rather than the rule.

The problems of post-irradiation reactions have not been serious. In properly selected chronic cases, reactions are not severe. Most patients report an exacerbation of their symptoms, usually an increased postnasal discharge, coming on from one to three days following treatment and persisting for another two to four days, followed by a gradual disappearance. Some have no reaction at all. Another group report their symptoms to have disappeared entirely in a few days. We have an occasional case where drainage becomes obstructed and the accumulated secretion within the sinus produces distress from pressure. These patients are promptly relieved by puncture and sinus washing. Sinuses with blocked drainage should never be treated until adequate drainage has been established by needle puncture, shrinking of the membranes, or other proper procedure.

As before stated, the technic has been varied according to the ideas of the therapist. The problem of the massive dose *versus* the fractional method has many times been brought to our attention. We still use the massive dose, *i.e.*, the full calculated dose given at one sitting, for the average patient. We have several times conducted a series of fractional doses in comparison with the massive dose, and it is our belief that we get a better percentage of results with the latter. Maxfield and Martin (10) report similar conclusions from their experience. We still use the fractional method in acute infections and in certain cases where we feel that a marked reaction may be expected. We are not inclined to take issue with those favoring a different technic, so long as they get the desired results. As in any other branch of medicine, the skill of the operator is the greatest factor in obtaining results.

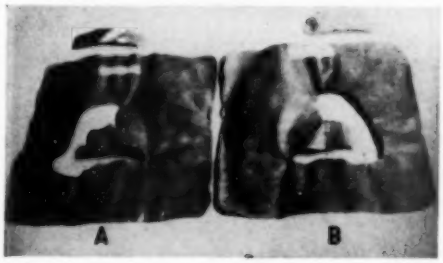
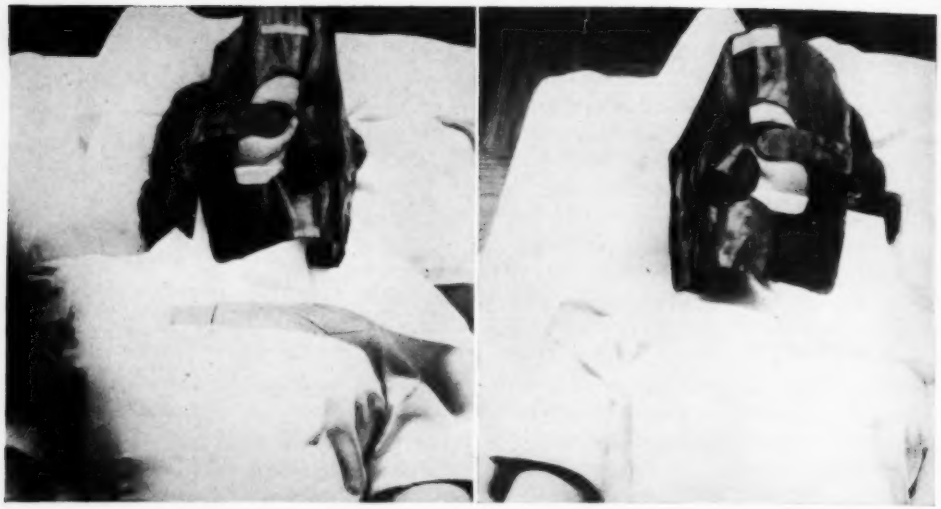


Fig. 1. Lead masks constructed in such fashion as to expose the maxillary, ethmoid, and frontal sinuses on one side of the face. The small pieces of lead above the masks are to be placed over the eyes. A. Mask for treatment of right side. B. Mask for treatment of left side.

In 1937 we began to experiment with the 200 kv.p. technic as compared with 120 kv.p. We found our results were equally satisfactory, and since that time we have given all of our sinus therapy with the heavier machine. Maxfield and Martin report the use of similar technic with satisfaction. We believe this to offer a decided advantage in that the greater filtration gives a much wider margin of safety from skin reactions. It also enables us to give the necessary exposure and cross-firing with fewer set-ups, thus reducing the cost to the patient. Third, and equally important, is the greater amount of radiation that can be given through the sphenoid sinuses.

Our routine procedure begins with a history and radiographic examination of the patient. A rhinologic examination is secured whenever possible. If treatment is to be given, the patient is placed supine upon the treatment couch. The head is rotated 35 to 40 degrees, depending upon the shape of the face, to the side opposite the sinuses that are to be treated. A lead mask, so constructed as to cover the cartilaginous part of the nose, the face, eyebrows, etc., is placed in position. This mask leaves an adequate port over the maxillary, ethmoid, and frontal sinuses to



Figs. 2 and 3. Masks in place for treatment of right and left sides. Notice that the eye and the cartilaginous part of the nose are protected.

the mid-line (Fig. 1). The central beam is directed obliquely posteriorly and slightly cephalad so that the rays pass through the exposed sinuses and the sphenoid (Figs. 2 and 3). The opposite side, if in need of treatment, is set up in similar fashion by a similar mask after the first side is treated. The post-ethmoid and sphenoid sinuses are thus cross-fired from both sides. In certain acute cases, when the principal involvement is in the antra and ethmoid cells, we sometimes employ the mask shown in Figure 4, directing the x-ray beam posteriorly and slightly cephalad. Under such circumstances we reduce the dosage to approximately one-third the amount given in the subacute and chronic cases and repeat the treatment after an interval of three or four days for a total of three sittings.

For the treatment of chronic sinusitis we now employ 200 kv.p., 20 ma., through the equivalent of 0.75 mm. copper and 3 mm. aluminum filter at a distance of 50 cm., H.V.L. 0.02 mm. copper; 300 r measured in air is given through each side. The patient is instructed to return in from six to eight weeks, or at an earlier date if his symptoms indicate need of attention. He is requested not to use nose drops or other medication during this interval. Upon his return, he is again checked over, and the necessity for further treatment is then considered. If all symptoms have cleared up and the roentgenograms show no evidence of infection, he is dismissed with instruction to report back if symptoms recur. If symptoms are not cleared up or roentgenograms show evidence of pathology, the procedure is repeated over such areas as are in need of further irradiation. If the patient can see no beneficial result and if the roentgenograms reveal no improvement, we believe that further treatment would probably be of no value. We have upon several occasions given further treatment under such circumstances and have obtained improvement in a few. We believe it to be a good policy not to be too readily discouraged, as good results have sometimes followed when an average response was not present at the six-week check-up.

Compilation of the published statistics of the six observers who have given such figures (2, 4, 6, 7, 10, 11), including both radiologists and rhinologists, reveal a general average of 33 per cent of those treated symptom-free, 41 per cent improved, and 26 per cent unimproved. Considering

Fig. 4. Lead mask for treating straight through all sinuses, sometimes used in acute cases.

these figures, it would appear that roentgen therapy has a definite place in the treatment of sinusitis, and that serious consideration should be given such treatment before subjecting the patient to radical surgical measures.

CONCLUSIONS

Roentgen therapy, skillfully applied, has a definite place in the present-day treatment of chronic sinusitis.

A general average of published statistics shows that 33 per cent of the patients so treated have been rendered symptom-free, 41 per cent have been improved, and 26 per cent unimproved.

In eleven years of experience in this field, the authors have encountered no harmful effects as the result of such therapy.

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DISCUSSION

Donald R. Laing, M.D. (Pasadena, Calif.): Dr. Butler and Dr. Woolley have been pioneers in the x-ray treatment of chronic sinusitis and have been successful. They have employed and continue to employ the large single dose method because they have found it more efficacious in their hands. My experience in the treatment of chronic sinusitis has been limited to the fractionated method. I have used one anterior and two lateral ports covering the sinuses and throat, treating three areas at one sitting, 100 r in air to each area, giving a total of 300 r per port in a seven-day period. The results have been very satisfactory in the hyperplastic type of the disease. Others using the fractionated pro-

cedure have also approached and equalled the results obtained with the single dose method. However, as Dr. Butler and Dr. Woolley have pointed out, the method is of secondary importance when the results are approximately the same.

Many radiologists have decried the lack of co-operation by the rhinologist. Only too often we must accept the blame. Some of us have failed fully to inform our fellow practitioners as to what we can and cannot do. Reiteration in the literature has made us aware that the selection of our cases of chronic sinusitis is very important. As soon as we forget that the hyperplastic type gives the better response to radiation, then we must be ready to accept poorer results and, inevitably, fewer patients. There are many points in favor of the x-ray treatment of chronic sinusitis, but this low-cost and comparatively simple method does not warrant routine acceptance of persons suffering from sinusitis.

The program of education must be carried to the rhinologist and beyond to the referring doctor, for the relationship of the family physician to the patient is much closer than that attained by the specialist. When a new mode of treatment is suggested by a specialist it is not unnatural for the patient to seek assurance from the general practitioner who has served him for years. Questions about the possibility of x-ray burns and injury to the eyes by radiation are foremost in the minds of patients. Some wonder about the effect upon the brain. Doctors, particularly pediatricians, are apprehensive about possible maldevelopment of the bones of the face and injury of the pituitary gland due to x-ray therapy. These questions may seem trivial to many of us, but clear concise answers in simple language will do much to allay the fears of the patient.

In my practice a brief talk with the patient before the administration of x-ray therapy has been invaluable in securing co-operation and understanding. An outline of the method to be followed and an elementary explanation of the physiological effects produced by x-ray are greatly appreciated by most persons. We must not forget that x-ray treatment, whether it is for cancer or chronic sinusitis, is a new and fearful procedure to many people. A simple adequate explanation of our mode of therapy will create a relationship of untold benefit to patient and radiologist alike.

Chronic Leukemia: A Statistical Study of Symptoms, Duration of Life, and Prognosis[1]

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CHRONIC LEUKEMIA varies greatly in the severity of its symptoms and in the duration of life. At the present time radiotherapy is the only method of treatment which appears to have a significant effect on the clinical manifestations and course. Yet only a few statistical studies of the symptoms and signs and their relation to prognosis and life expectancy have been published. The following analysis is based on 64 patients with myeloid and 64 with lymphatic leukemia treated by x-rays at the Presbyterian Hospital in New York between the years 1919 and 1939, inclusive. Cases in which the duration of life was less than four months from onset of symptoms were classified as acute and are not included in this study. The few cases diagnosed as monocytic, basophilic, and eosinophilic leukemia were placed under the two main classifications of myeloid and lymphatic.

TREATMENT TECHNIC AND RATIONALE

All patients with chronic leukemia received x-ray therapy according to the technic set forth in Table I. Local application was the method employed in all but 2 cases, in which general body irradiation was given. In the early years medium voltage was used; later only high-voltage therapy was given. The factors for the latter were usually as follows: 200 kv., 8 or 25 ma., 50 cm. T.S.D., and 1.0 mm. Cu plus 1.0 mm. Al filter. The skin over the spleen was given 25–50 r once or twice a week for several weeks, after which a dose of about 75 r was administered routinely once a week. If enlarged peripheral lymph nodes were present, they received an initial dose of 50 r at the same time, which, after one or two weeks, was elevated to 100 r weekly. The usual supportive measures, the most important of which was transfusion, were employed when indicated. The treatment was in all cases individualized, since the aim was not only to reduce the white blood count and to shrink the palpable masses but also to maintain the patient in an optimum state of well-being and efficiency for as long a period as possible.

TABLE I: TECHNIC OF ROENTGEN THERAPY IN CHRONIC LEUKEMIA

Voltage (kv.p.)	Ma.	T.S.D. (cm.)	Filtration
130	4	25	3.0 Al
158	4	40	0.5 Cu + Oil or 1.0 Al
190	8	50	1.0 Cu + 1.0 Al
200	25	50	1.0 Cu + 1.0 Al

Spleen: Through 1930 with doses of 75–150 r* (medium and high voltage); after 1930 with doses of 35–100 r (high voltage), 75 r being the standard dose.

Lymph nodes: Up to 1933 with doses of 100–200 r (medium voltage); since 1933 with doses of 50–100 r (high voltage).

* Roentgens measured in air, without backscatter.

ANALYSIS OF CLINICAL MATERIAL

Age: The average age of the patients with myeloid leukemia was 41.1 years and of those with lymphatic leukemia, 49.6 years. These figures conform quite well with the literature as a whole (1–6).

Sex: More males than females have leukemia, the figures quoted in the literature varying from 60 to 80 per cent. Of our series 69, or 54 per cent, were men. The 64 myeloid cases were equally divided between males and females. Of the lymphatic group, 37 (58 per cent) were males and 27 (42 per cent) females.

INITIAL SYMPTOMS AND SIGNS

Weakness and loss of weight occurred about one and one-half times as frequently in the patients with myeloid leukemia as

[1] From the Departments of Radiology of the Presbyterian Hospital and of the College of Physicians and Surgeons, Columbia University, New York. Accepted for publication in March 1942.

in those with lymphatic leukemia, in 70 and 66 per cent as compared with 47 and 38 per cent, respectively. About one-third of all patients, whether of the myeloid or lymphatic group, complained of fatigue. Somewhat less than one-half, *i.e.*, 44 per cent of the patients with myeloid leukemia presented some symptom related to splenic enlargement, such as pain, dyspnea, swelling, heaviness, constipation, etc.; for the lymphatic group the figure was 27 per cent.

TABLE II: INITIAL SYMPTOMS AND SIGNS IN CHRONIC LEUKEMIA

	Myeloid	Lymphatic
Splenomegaly	97%	78%
Less than 5 cm. below costal margin	12	46
Between 5 and 8 cm. below costal margin	13	12
More than 8 cm. below costal margin	75	42
Lymphadenopathy	35%	83%
Cervical	25	81
Axillary	22	72
Inguinal	24	72
Other superficial	5	36
Mediastinal	3	25
Generalized	0	19
Fever	72%	81%
Hemorrhage (from gums, nose, rectum, etc.)	27	25
Retinitis	24	6
Generalized eruption	0	5
Leukemic infiltration of skin	2	4

The first complaint of 63 per cent of the patients with lymphatic leukemia was enlargement of the superficial nodes; 20 per cent of the myeloid group complained of enlarged nodes.

Splenomegaly: There is little difference of opinion concerning the high incidence of splenomegaly in patients with myeloid leukemia. All of our patients but one had an enlarged spleen and he had undergone a splenectomy elsewhere before admission to this hospital.

Initial splenomegaly in lymphatic leukemia was nearly as frequent, occurring in 78 per cent (Table II). It is of interest that 75 per cent of the patients with myeloid and 42 per cent of those with lymphatic leukemia had spleens which projected 8 cm. or more below the costal margin. It would appear, therefore, that the size of the spleen is of questionable aid in the differential diagnosis of these two types.

Lymphadenopathy: Opinions differ concerning the frequency of lymphadenopathy in myeloid leukemia. Craver (7) states that in the typical case one finds "as a rule, practically a total absence of signs of enlargement of lymph nodes." Most textbooks, however, would lead one to believe that the superficial nodes are frequently pathologically enlarged and palpable. In our study support is found for the latter opinion, since in 35 per cent of the patients with myeloid leukemia one or more groups of nodes were initially palpable (Table II). Enlarged nodes were present in 83 per cent of the patients with lymphatic leukemia. Thus, it would seem that the presence or absence of lymphadenopathy is not reliable evidence in the differential diagnosis.

Miscellaneous Signs: The incidence of fever and hemorrhage was approximately the same in both types of leukemia. Retinitis was four times as common in the myeloid as in the lymphatic type. Evidence of skin involvement, such as a generalized eruption or leukemic infiltration, was seen in 9 per cent of the patients with lymphatic leukemia and in only 2 per cent of those with myeloid leukemia (Table II). Involvement of bone, lung, and nerve is uncommon. Craver and Copeland (8) found bone involvement in 1 of 83 patients with myeloid and 6 of 86 patients with lymphatic leukemia. Only one of our patients with chronic myeloid leukemia and none with chronic lymphatic leukemia had evidence of the disease in the osseous system.

Initial Blood Picture: The average blood picture on admission is as follows: for the myeloid type, red cells 3,160,000, white cells 216,960, hemoglobin 56.6 per cent, color index 0.92, platelet count 214,830; for the lymphatic type, red cells 3,850,000, white cells 134,214, hemoglobin 87.6 per cent, color index 0.92, platelet count 106,610. While the relationship between the red count and hemoglobin remained unchanged for the two types of leukemia as evidenced by the same color

index value, the anemia was more pronounced in the myeloid type. This form also exhibited a greater elevation in white blood count with a higher predominance of primitive cells. As for the platelet count, one would expect it to be lower in the lymphatic type, in which an increased bleeding tendency is more frequently encountered. This was shown by our figures to be true of the cases in which accurate estimations had been made.

When first seen, the patients with chronic myeloid leukemia give the impression of being more seriously ill than those with chronic lymphatic leukemia. The statistics obtained from our study lend confirmation to this impression. They are revealing, furthermore, in that they demonstrate why in some instances a differential diagnosis is not possible purely on clinical grounds without the aid of hematological studies.

DURATION OF LIFE

The duration of life from onset of symptoms in chronic leukemia varies from two to four years, according to figures collected by Leucutia (9) from the literature up to 1934. Marchal, Mallet, and Bellin (10), Leavell (5), Dale (11), Harrison and Reeves (6), and Jackson (12) have since published figures which do not deviate significantly from the above. Our figures, while falling within these limits, are more nearly in agreement with those of Wintrobe and Hasenbush (14), which show for chronic myelogenous leukemia an average duration of life, from onset of symptoms, of 2.79 years and for chronic lymphogenous leukemia an average of 2.33 years. We arrived at the corresponding periods of 2.5 years and 2.8 years, as shown in Table III.

Notwithstanding the lack of evidence of improvement in life expectancy, it is established beyond doubt that x-ray therapy is the best means available at the present time for the production of remissions during which the patient may lead a normal and efficient life. Furthermore, in spite of these statistics, it is difficult not to believe that in an occasional patient life has been prolonged.

PROGNOSTIC FACTORS

The prognosis of chronic leukemia, according to opinions expressed in the literature, is unfavorably affected by a number of factors, namely, a high or a very low white blood count, serious anemia, a high number of blast cells, an excessively low platelet count, enormous enlargement of the spleen, diffuse involvement of the nodes and the presence of complications such as hydrothorax, cardiovascular disease, tuberculosis, pneumonia, and osteomyelitis. There have been few reports giving statistics to substantiate these opinions. Wintrobe and Hasenbush (14) analyzed a series of 86 cases and found that the presence of infection in most instances failed to bring about a depression in the leukocyte count and clinical improvement. Lobar pneumonia occurred in 7 of the lymphogenous patients and proved fatal in 6. A notable difference was the absence of this type of pneumonia in myelogenous leukemia.

Bethell (15) showed that the duration of life from the onset of symptoms in the various types of lymphogenous leukemia was apt to be greater if a subleukemic blood picture was present at some time. For instance, those patients with a leukemic blood picture which subsequently became subleukemic had an average survival period of 38.7 months; those with a subleukemic picture throughout, 27.5 months; those with a leukemic picture

TABLE III: AVERAGE SURVIVAL PERIOD AFTER FIRST SYMPTOM IN CHRONIC LEUKEMIA

	Myeloid	Lymphatic
Of the 128 patients there are at present dead (includes 25 per cent of the myeloid and 21 per cent of the lymphatic group lost to follow-up)	95.0 per cent	85.5 per cent
Average survival for 128 patients	2.5 yr.	2.8 yr.
Lived more than three years	34.4 per cent	35.9 per cent
Lived more than five years	5.0 per cent	14.5 per cent

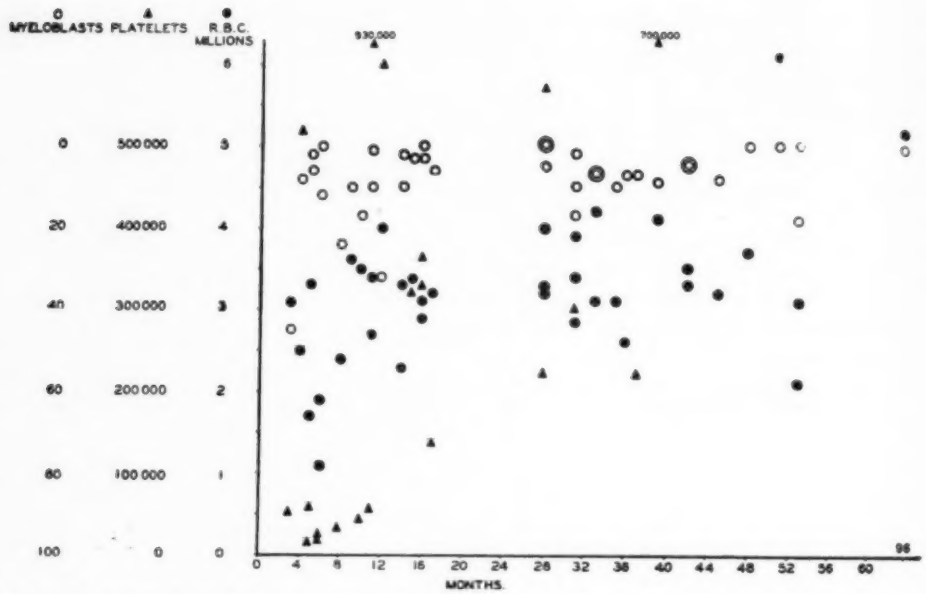

Fig. 1. Relation of survival period to red blood count, platelet count, and primitive cells in chronic myeloid leukemia.

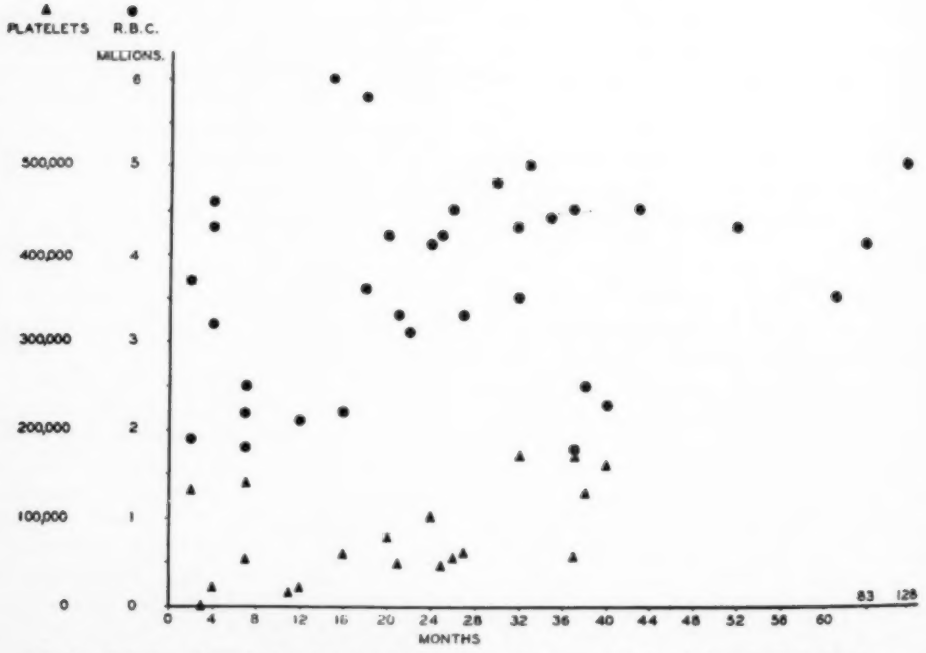

Fig. 2. Relation of survival period to red cell and platelet counts in chronic lymphatic leukemia.

throughout, 22.6 months; and finally, those with a change in the blood picture from subleukemic to leukemic, 9.9 months. Leavell (5) studied 87 patients with chronic myeloid and 49 with chronic lymphatic leukemia and concluded from statistical reasoning that those patients with either a marked anemia, a low leukocyte count, or evidence of bleeding before treatment, had a shorter duration of life. Furthermore, the likelihood of an early fatal outcome was greater if more than one of these findings were present. Our studies seem to show that a low red cell count with an abnormally low or high platelet count is likely to be associated with a short survival period regardless of treatment. Those patients with myeloid leukemia who on first admission had a red count below 3 million and platelets below 50,000 or above 500,000 survived less than one year from the onset of symptoms (Fig. 1). Similarly, the patients with lymphatic leukemia having a red cell count under 3.5 million and platelets under 75,000 survived two years or less (Fig. 2).

TABLE IV: SURVIVAL PERIODS IN RELATION TO DURATION OF SYMPTOMS BEFORE TREATMENT

Duration of Symptoms before Treatment	Myeloid		Lymphatic	
	Years	Patients	Years	Patients
Less than 6 months.	2.2	31	1.8	18
6 months–1 year....	2.3	11	2.3	18
1 year–2 years.....	3.1	5	2.7	11
2 years or over.....	3.9	5	5.0	12

There is one other factor which apparently has a bearing on life expectancy, namely the nature of chronic leukemia as differentiated from the acute form. Craver (13) raises the question: "Is the leukemia which kills in a month the same disease as that which lasts fifteen years?" For in very rare instances one may be consulted by a patient who complains of a sudden increase in size of lymph nodes which had already been enlarged for several years with no impairment of general health. Again, a diagnosis may be made during observation for some other ailment, the patient at no time having any complaints directly referable to the leukemia accidentally discovered. Consequently, it is reasonable to assert that certain patients will do well even without treatment. The figures in Table IV indicate the possibility for a longer survival in those persons who have a longer duration of symptoms before institution of therapy.

SUMMARY

1. Initial splenomegaly in the patient with lymphatic leukemia and initial lymphadenopathy in the patient with myeloid leukemia are more common than has been supposed.

2. Although remissions were effected whereby the patient's comfort and efficiency were improved, we have found no positive evidence that the average duration of life in chronic leukemia has been prolonged by roentgen therapy as applied in these cases.

3. A short survival period is probable in chronic leukemia if the red cell and platelet counts are extremely low at the initial visit to a physician.

4. Chronicity, measured by the duration of symptoms before the patient seeks medical aid, has a definite bearing on survival: the more chronic the disease, the longer is the life expectancy.

Note: I wish to express my sincere appreciation to Dr. Maurice Lenz, Dr. Ross Golden, and Dr. Kenneth McAlpin for their generous help and criticism.

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An Interesting Malpractice Suit[1]

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AN INTERESTING and instructive decision in a medical malpractice suit was rendered by the Kansas Supreme Court, subsequent to an appeal to that court, about two years ago.

The main particulars are substantially as follows: The plaintiff, Mrs. R., accompanied by her husband and her mother, consulted Dr. G., the defendant, to whom she had been referred by her family physician. Mrs. R. had borne a child about six months previously and at the time of her visit to Dr. G. was complaining of some pelvic disturbance.

After making the usual pelvic examinations, Dr. G. made a diagnosis of tumor, probably of the ovary. On Sept. 9, 1937, he operated on the plaintiff and found a large pelvic mass, which he decided was inoperable. He removed tissue specimens for frozen section examination, and when these were declared malignant he closed the abdomen and recommended roentgen therapy. Peritonitis followed, necessitating reopening of the abdomen, and some four months later another operation was done to relieve an intestinal obstruction.

Shortly after returning home from the hospital after this latter operation, the plaintiff consulted two osteopaths and later brought suit against Dr. G., alleging that he had been negligent in failing to use the usual, regular, and approved methods of arriving at a diagnosis of her ailment; that he had wrongly diagnosed the condition as sarcoma; that he had incorrectly and improperly subjected her to roentgen therapy, and that as a result of his negligence and faulty treatment she had sustained pain, impairment of her health, and permanent and irreparable injury. For this she claimed $25,000.

The trial court overruled a general demurrer and denied the defendant's motion for a directed verdict. The defendant thereupon appealed to the Kansas Supreme Court, whose opinion reads in part as follows: "According to the testimony of the plaintiff, she and her attending physician had informed the defendant that she had been running an elevation of temperature, had been having continuous pain in the left side of her abdomen for more than three weeks and that she had had nausea and vomiting. Also that the defendant had failed to take her temperature or her blood pressure but that he did take her pulse, and that he palpated her abdomen and made a vaginal examination, which he said revealed the presence of a pelvic tumor about the size of a small grapefruit. The plaintiff's mother testified that defendant failed to make a count of plaintiff's blood or to make or have made x-ray pictures; that before the first operation he told her that her daughter had an ovarian tumor, and that after the operation he said that her daughter had a sarcoma of the ovary and would live only a few months. She further testified that three days after the operation defendant told her that, even though the pathologist's report did not positively show a sarcoma, he still believed that her daughter had cancer, and that roentgen-ray treatment, which would tend to retard the growth, would have to be given. According to the mother's testimony, the defendant discontinued treatment of plaintiff and placed her under the care of other physicians whom he had instructed as to the treatment. This witness claimed that defendant did not withdraw from the case until March 1937."

The hospital records in this case showed that defendant's preoperative diagnosis was "tubo-ovarian abscess" and that his postoperative diagnosis was "retroperi-

[1] Presented before The Chicago Roentgen Society, Nov. 13, 1941. Accepted for publication in December 1941.

toneal sarcoma; adhesions to iliac vessels and ureter are so dense that removal is impossible."

The report of the pathologist who made the microscopic examination of the biopsy specimens was introduced in evidence. The diagnosis in this report was "cellular neurofibroma."

An osteopath, who described himself as a specialist in roentgenologic diagnosis, testified that the authoritative technic in the use of the x-rays in the allopathic and osteopathic schools is the same, and that the roentgenograms made in March 1937, about five months after the first operation and subsequent to the roentgen treatments, did not show any evidence of sarcoma; but, he added, "if there had been a sarcoma present before the plaintiff had received the x-ray treatments, it is possible that the tumor had entirely disappeared and could not be seen in the films then being examined." He further testified that the presence or absence of fever would have no bearing on the presence of sarcoma in that location but that fever would be more indicative of an abscess.

Two other osteopaths who were consulted by the plaintiff testified that the approved method of diagnosing benign or malignant tumors consists in taking a history, a physical examination, and microscopic examination of tissues; that x-ray examinations and laboratory tests are sometimes of value. They further testified that the defendant should have been able, by the use of these methods, to eliminate the presence of a malignant tumor before the original operation. In the opinion of these two osteopaths the plaintiff did not have a sarcoma at the time defendant first examined her.

Several physicians (doctors of medicine) testified that the means and methods of diagnosis and of treatment used and applied by the defendant were such as are used and followed by physicians and surgeons in good standing in that community.

The Kansas Supreme Court, in determining whether the plaintiff's evidence was sufficient to establish a prima facie case, said: "Every reasonable inference from the plaintiff's evidence favorable to her must be indulged in, but the defendant's evidence cannot be considered except as far as it may be supplementary to the plaintiff's evidence. A physician is not a guarantor of the correctness of his diagnosis or of the efficacy of his treatment (48 C.J. 1119); but he is required to exercise the degree of skill and learning ordinarily possessed and exercised under similar circumstances by the members of his profession in good standing and to use ordinary and reasonable care and diligence and his best judgment in the application of his skill to the case (C.J. 1113). Negligence cannot be presumed from mere failure to obtain the best results. The general rule is that, to establish liability, it must be shown by expert medical testimony that the physician lacked the skill or failed to follow the approved procedures and methods of treatment. This general rule, however, applies only to such matters as are clearly within the domain of medical science, and matters that are within the common knowledge may be testified to by anyone familiar with the facts. It is also a general rule that a member of one school of medicine is not permitted to testify as to whether a defendant belonging to another school of medicine has employed the approved procedure or treatment of his own school. This rule, however, has been modified by many courts to the extent that where two schools teach and practice the same methods of diagnosis or treatment in connection with the particular ailment or branch of medicine involved in the case, testimony may be received from a practitioner who does not belong to the same general school as that of the defendant (21 R.C.L. 383). The defendant in the present case contended that the osteopaths who had attended the plaintiff were not competent to testify concerning the procedure or methods of diagnosis and treatment used by him, a physician of the allopathic school. The court is of the opinion that there might be doubt whether the facts

presented in the present case were within the qualification of the rule so as to make the testimony competent. As to diagnosis, that doubt had been resolved in favor of the plaintiff because there was testimony that for instruction in diagnosis of tumors, malignant and non-malignant, the schools have generally used the same textbooks written by allopathic doctors and that substantially the same methods of diagnosis are used by the two schools.

"There was no evidence that proper care had not been taken by the defendant in making his tentative diagnosis, or that his recommendations of an operation after such diagnosis constituted malpractice; or that the operation was not performed by him in an efficient and professional manner. The only substantial question remaining, therefore, was whether he was negligent in causing roentgen-ray treatments to be administered. At the time of the operation the defendant found that the tumor mass was in such a position that it could not be removed and no attack was made on that conclusion. His procedure in removing two specimens of tissue for pathological examination was not attacked, nor was it contended that Dr. Hellwig was not a qualified pathologist. None of the witnesses for the plaintiff contended that biopsy is not an approved method of determining whether a growth is malignant or non-malignant. In fact, the osteopath who interpreted the roentgenograms taken on March 8, 1937, testified that microscopic examination of tissue taken for biopsy is the most important method for diagnosing a malignant growth. In the opinion of this court, the plaintiff's evidence failed to support any allegation that the employment of biopsy or reliance placed in laboratory diagnosis of malignancy constituted malpractice. On the contrary, it might be argued that the defendant would have been guilty of malpractice if he had not had such microscopic examination made and given weight to the report. The only effect of the testimony of the osteopathic witnesses was that, when they examined the plaintiff subsequent to the roentgen-ray therapy, she did not have a sarcoma, and that the defendant should have diagnosed a non-malignant condition prior to the operation. But the defendant's diagnosis prior to the operation was that the plaintiff had a tubo-ovarian abscess, a non-malignant condition.

"This court concludes, therefore, that the plaintiff failed to show that the defendant's methods of diagnosis were not such as are generally approved by the medical profession in the community or that the use of the roentgen-ray treatment following his own diagnosis and the report of the microscopic examination was not an approved treatment. Accordingly this court holds that the trial court erred in overruling the defendant's demurrer and in overruling his motion for a directed verdict. This court therefore remands the case, with directions that judgment be entered for the defendant."

The foregoing is so clear that there is not much left to discuss, except that it is apparent that the suit was instigated by the osteopaths. It is almost equally evident that the admission of the testimony of the osteopaths by the trial judge was in error.

Other points brought out by the writer of the foregoing opinion for the Kansas Supreme Court are similar to if not quite the same as those which have been expressed by courts of last resort elsewhere. With the tendency of the public toward bringing malpractice suits, it is well for us that we keep these points in mind, not that we should pose as authorities in malpractice law, but that we be better able to advise our lawyers if, as, or when it may be necessary.

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Mucosography of the Respiratory Tract[1]

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THE INTERNAL surface of the organs of the respiratory tract can be studied radiologically by coating their mucosa with a very thin layer of an opaque substance. This may be accomplished by vaporizing the opaque medium at the vestibule of the larynx so that, as it is inhaled by the patient in fine particles, it is deposited along the mucosa of the larynx, trachea, and bronchi. Films taken immediately after inhalation enable us to study the finest details of the mucosa of these organs. The mucosal surface appears as a thin but dense line that contrasts beautifully with the air within the organs.

TECHNIC

The pharynx and larynx are anesthetized with 2 c.c. of a 2 per cent solution of pantocaine and the trachea with 1 c.c. of a 1 per cent solution of pantocaine. We then begin the vaporization of the opaque medium (Merck's 40 per cent solution of neo-iodipin) with an atomizer, introducing its curved end behind the epiglottis. The atomizer is connected to a pump such as used by the laryngologist, in order that the necessary amount of the medium may be vaporized in a few minutes (Fig. 1).

For the examination of the larynx and upper part of the trachea only 5 c.c. of neo-iodipin are needed. The patient is placed in the sitting position and instructed to breathe deeply during the vaporization. Anteroposterior and lateral films are taken immediately after inhalation.

For the examination of the lower portion of the trachea, larger bronchi, and bronchi of the lower pulmonary lobes, about 15 c.c. of the medium are needed. The patient is placed in the sitting position and inclined to the side to be explored. Anteroposterior and lateral views are taken immediately.

When the lesion is located in the upper pulmonary lobes the vaporization is made and the films are taken with the patient in the horizontal position and inclined toward the affected side. For lesions in the vertex the patient is placed in the Trendelenburg position.

Fig. 1. Drawing illustrating the technic of mucosography. The curved end of the atomizer has been introduced behind the epiglottis under guidance of the laryngeal mirror and vaporization of the contrast medium has been started.

INTERPRETATION

Larynx: In the lateral films of the normal larynx we are able to trace the contour of the base of the tongue, valleculae, the epiglottis, the aryepiglottic folds, the piriform sinuses, the anterior commissura, the ventricles of the larynx, the true and false vocal cords, and the trachea (Fig. 2). Sagittal films of the larynx show the same structures but not superimposed as in the lateral view (Fig. 3).

When a pathological process such as a neoplasm is present in the larynx, the structures in that area are deformed and the mucosal aspect is altered (Fig. 4). The sagittal view will show the affected side without superposition (Fig. 5).

[1] This work has been done at the Cancer Institute in collaboration with Drs. Llambés and Cárdenas. Presented by title before the Radiological Society of North America, at the Twenty-seventh Annual Meeting, San Francisco, Calif., Dec. 1–5, 1941.

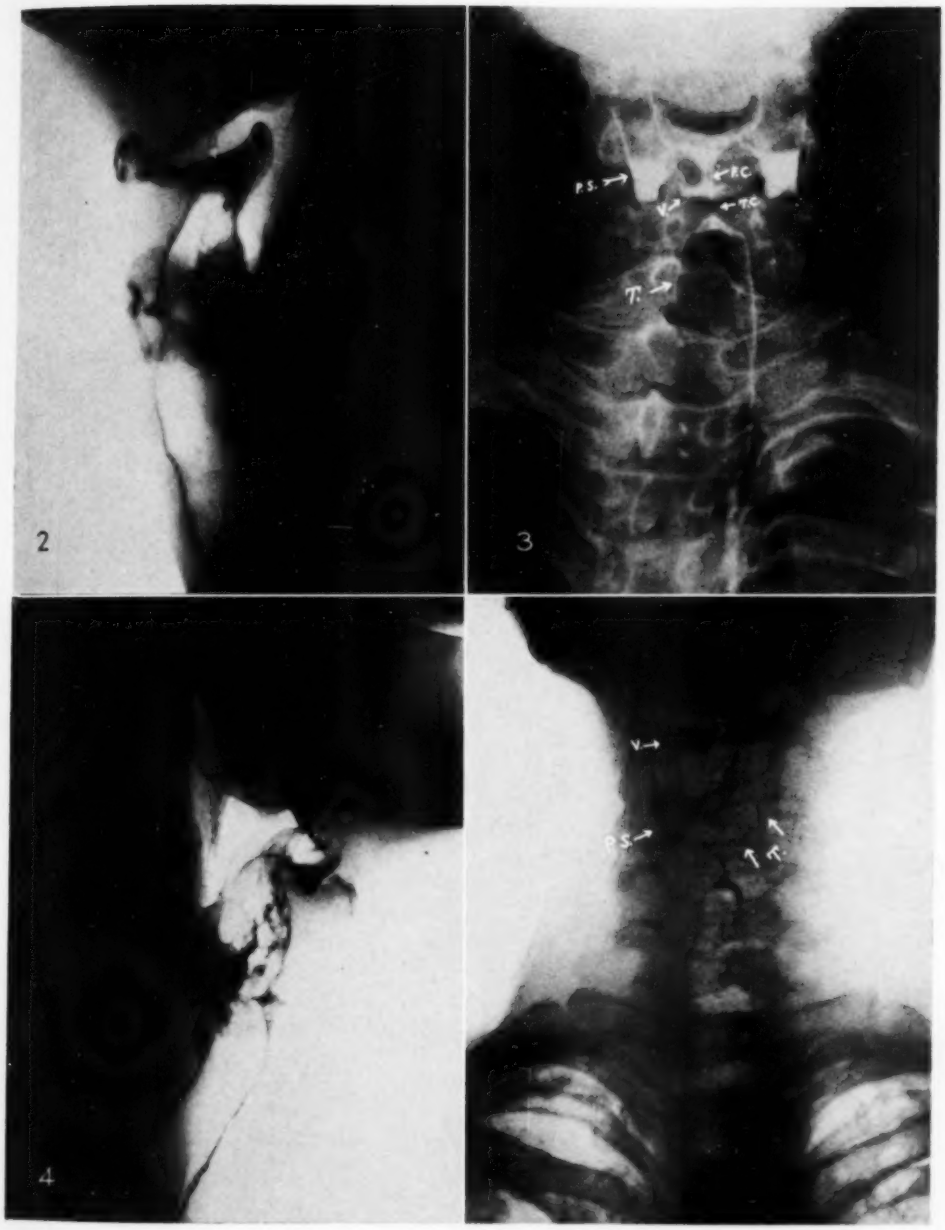

Fig. 2. Mucosography of the normal larynx: lateral view showing the internal surface covered with a thin layer of opaque medium contrasting beautifully with the air within.

Fig. 3. Mucosography of the larynx: anteroposterior view. P.S. Piriform sinuses. V. Ventricles. F.C. False vocal cords. T.C. True vocal cords. T. Trachea.

Fig. 4. Malignant tumor of the left aryepiglottic fold. Large ulceration of the left side of the laryngeal vestibule.

Fig. 5. Sagittal view of the case shown in Fig. 4. The left piriform sinus is occupied by the tumor.

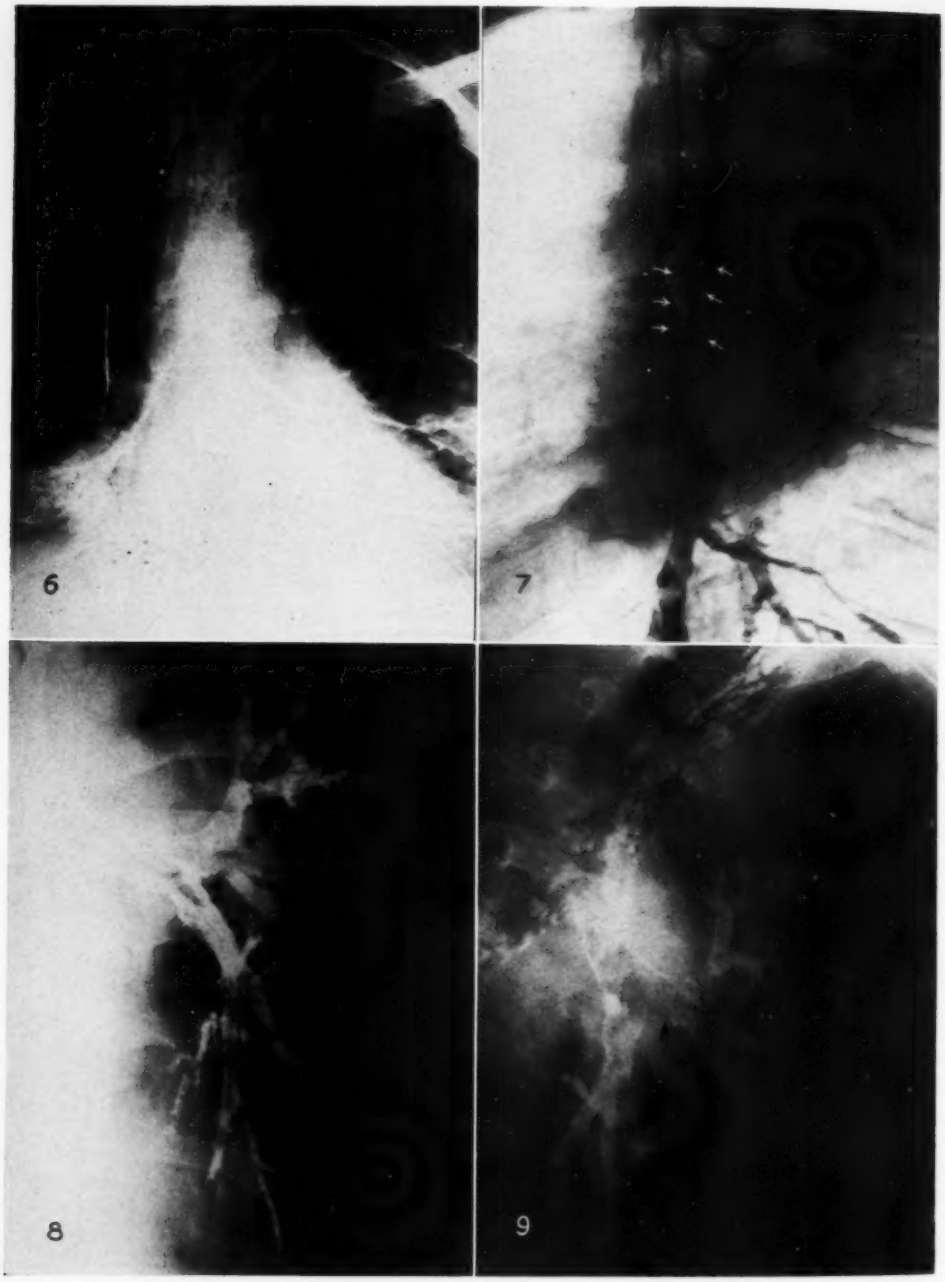

Fig. 6. Normal large bronchi, the internal surfaces of which appear as dense, thin lines.
Fig. 7. Mucosography of the trachea (lateral view), showing a malignant papilloma. Case proved by bronchoscopy and biopsy.
Fig. 8. The dense lines showing the contour of the bronchi at the entrance of the bronchus corresponding to the middle lobe are destroyed by an infiltrating process. The lumen of this bronchial segment is not altered.
Fig. 9. Lateral view of case pictured in Fig. 8, showing the alteration of the contour without modification of the lumen. Six months later this bronchus was completely obstructed.

Fig. 10. Extensive tumor of the left hilum compressing the main left bronchus without infiltrating it. Complete obstruction by infiltration of the bronchus of the lower lobe.

Trachea and Bronchial Tree: In the films of the normal trachea and bronchial tree the contour of these organs is revealed by thin dense lines, in sharp contrast to the air within (Fig. 6). When a neoplastic process is present in the trachea, the tumor is outlined by the opaque medium and can be seen very clearly (Fig. 7). In cases where an infiltrating process takes place in the larger bronchi the contour of the altered area can be seen, although the bronchial caliber has not yet been reduced (Figs. 8 and 9). If the bronchial lumen is completely filled, as it is in regular bronchography, this image of the altered mucosa may be entirely lost. When the infiltrating process obstructs the bronchus, the opaque medium accumulates above the stenosis, giving the same aspect as in regular bronchography (Fig. 10).

This method is harmless, avoids all trauma of the glottis, is well tolerated by the patient, and is easy to apply in the x-ray department.

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Calcification of the Gallbladder: Roentgenographic and Pathologic Study[1]

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CALCIFICATION of the gallbladder is sometimes an incidental necropsy finding in older patients. Its occurrence has been reported by Robb (1) and others (2–10). The condition in itself seldom produces clinical symptoms, but its close relationship to chronic gallbladder disease and the problems involved in differential diagnosis are of utmost importance. Three proved cases of calcified gallbladder will be presented, and 3 cases in which this diagnosis was suggested by the roentgenograms but was not surgically verified.

CASE REPORTS

CASE 1: T. D., a 40-year-old colored woman, was admitted to the Cook County Hospital Nov. 19, 1938. She had been well until two years before admission, when she began to experience dull right upper quadrant pain, which radiated around the right side of the abdomen to the back, just beneath the right scapula. She complained, also, of belching and bloating, and a sense of fullness in the epigastrium following the ingestion of a moderately heavy meal of fatty or fried foods. There had been a loss of weight amounting to 30 pounds in the past year. No history of acute biliary colic was obtained.

The patient did not appear acutely ill. The essential physical findings were confined to the abdomen: tenderness and rigidity in the right upper quadrant and a firm palpable mass extending 4 inches below the right costal margin. Blood and urine findings were within normal limits.

Cholecystography, two days before admission, in the Outpatient Clinic, revealed a well defined calcareous shadow conforming in position and contour to the gallbladder (Fig. 1). The clinical diagnosis was chronic cholecystitis and cholelithiasis.

An exploratory laparotomy was performed on Nov. 28. The gallbladder was the size of a peach. Its serosal surface was pale and the adherent subjacent wall was calcified, with areas of calcification extending also into the muscularis. A small stone was found in Hartmann's pouch. The liver was of good color and contour. The head of the pancreas was somewhat indurated. Recovery was uneventful.

The gallbladder measured 8.5 × 5.0 × 4.25 cm., with thickening of the wall to as much as 5 mm., including the fundus and body and extending to the duct. Diffuse calcification was present, particularly over the inner aspect. Attached to the wall by a soft yellowish-gray material were numerous facetted stones, measuring up to 10 mm. in diameter (Fig. 2). The inner lining was yellowish gray and partially calcified. Microscopic examination showed dense fibrous connective tissue infiltrated by streaks and plaques which stained black by the von Kossa technic (calcium) (Fig. 3). The diagnosis was calcified gallbladder and cholelithiasis.

CASE 2: O. N., a 46-year-old white woman, was admitted to the Cook County Hospital June 8, 1939, with a diagnosis of chronic cholecystitis and cholelithiasis. She gave a history of attacks of gallbladder colic dating back to 1918, but was relatively symptom-free from 1923 to February 1939. An appendectomy and salpingectomy were done in 1918.

The findings on physical examination were of slight significance except for some tenderness in the mid-epigastrium. Blood studies showed hemoglobin 75 per cent; red blood cells 4,350,000; white blood cells 6,250; non-protein nitrogen 33 mg. per 100 c.c.; uric acid 4.4 mg. per 100 c.c.; Kahn test negative. Albumin was present in the urine (3 plus).

Roentgen examination, June 6, 1939 (Fig. 4), revealed a huge oval shadow with calcareous periphery to the right of the 11th and 12th dorsal vertebrae.

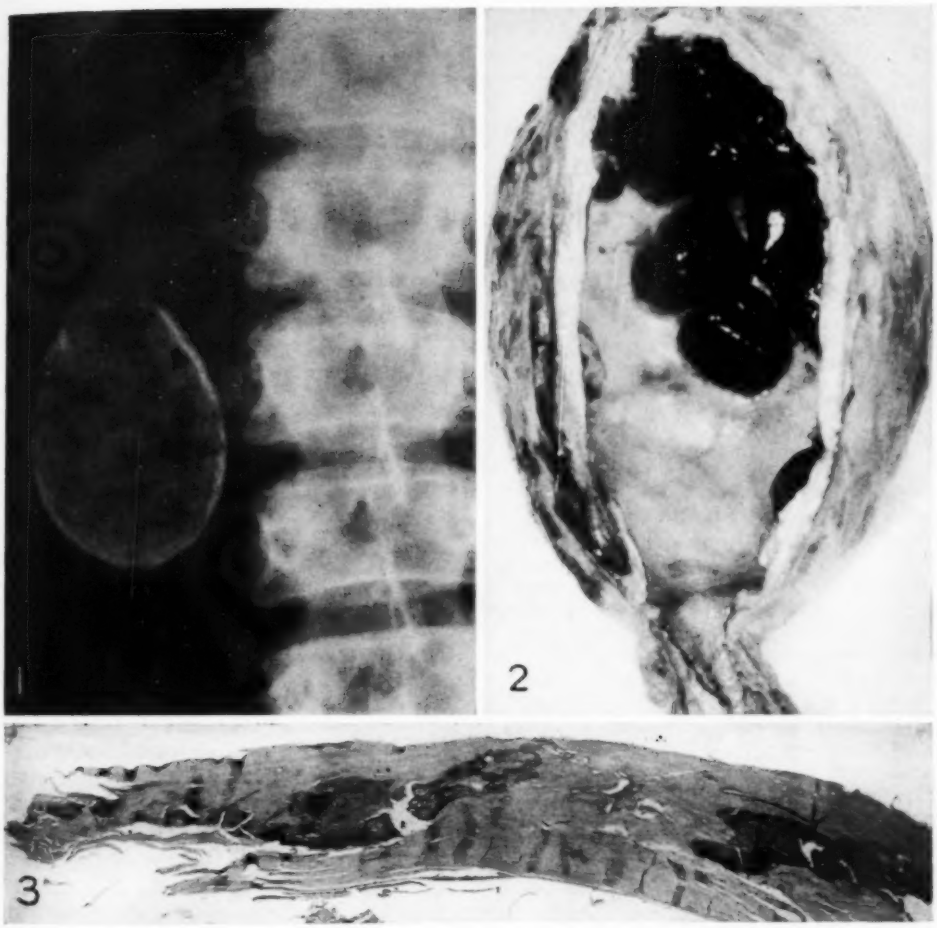
At operation, June 19, 1938, the gallbladder was found to be merely a calcium shell, filled with a putty-like material. A cholecystectomy was done and recovery was uneventful.

The gallbladder measured 7 × 4.5 × 4.5 cm. The wall, for the most part, was calcified (Fig. 5). The putty-like material filling the lumen was in part liquefied and mixed with cholesterin crystals. Microscopic examination revealed severe chronic cholecystitis with focal areas of calcification.

CASE 3: M. H., a 56-year-old white woman, was admitted to the Cook County Hospital April 5, 1940, with a diagnosis of chronic cholecystitis. She complained of pain across the abdomen for one year, belching for two years, and a recent loss of weight of 29 pounds. She had an aversion to fatty foods.

Physical examination, on admission, revealed a slight hypertension (blood pressure 160/100). A questionable mass was felt below the liver. Blood

[1] From the Departments of Roentgenology and Surgical Pathology, Cook County Hospital, Chicago, Ill. Accepted for publication in February 1942.



Figs. 1–3. Case 1: Fig. 1. Cholecystogram showing a well defined calcareous shadow conforming in position and contour to the gallbladder. Fig. 2. Calcified gallbladder and stones. Fig. 3. Low-power photomicrograph showing foci of calcification in the wall.

studies showed hemoglobin 98 per cent; red cells 5,020,000; white cells 8,400; non-protein nitrogen 25 mg. per 100 c.c.; Kahn test negative. Urine examination was negative. The Ewald meal showed: free hydrochloric acid 0; total acid 10 per cent. The stools were negative for blood.

A barium meal study, April 2, 1940, was negative, but a shadow with a calcareous periphery was observed, corresponding to the gallbladder in shape and position (Fig. 6).

An exploratory operation, May 4, revealed a large, distended, thick, yellowish-white gallbladder with many pericholecystic adhesions. Its wall was thick and granular and could be cut only with the greatest difficulty. Six large stones of mixed type were present, with white milky bile. A cholecystectomy was done, with uneventful recovery.

The gallbladder measured 7.5 × 5.5 × 4.5 cm. The serosa was thickened and purple-red to gray. The wall measured up to 12 mm. in thickness and was calcified. A greenish-gray purulent material filled the lumen, together with numerous facetted stones measuring up to 12 mm., composed of bile pigment and cholesterol. The microscopic diagnosis was calcified gallbladder.

CASE 4: B. U., a 62-year-old colored woman, was admitted to Cook County Hospital July 9, 1939, with a diagnosis of metastatic carcinoma of the liver. She complained of intermittent attacks of right upper quadrant pain, nausea, and vomiting for twenty years, usually precipitated by eating cabbage or fried foods. For a year there had been a hard lump in the right upper quadrant, tender on palpation and painful during an attack.

Fig. 4. Case 2: Calcified gallbladder shadow to right of the 11th and 12th dorsal vertebrae.

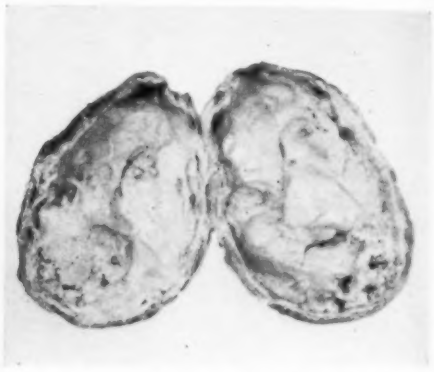


Fig. 5. Case 2: Partially calcified gallbladder. Note putty-like contents.

The essential finding on physical examination was an enormous hard mass in the right side of the abdomen, extending down into the pelvis; the mass appeared to be separate from the liver.

Blood studies showed hemoglobin 88 per cent; red cells 4,510,000; white cells 23,450 (neutrophils 73 per cent, basophils 0, eosinophils 0, lymphocytes 15 per cent, monocytes 9 per cent, band forms 3 per cent); non-protein nitrogen 34 mg. per 100 c.c.; uric acid 47 mg. per 100 c.c.; icteric index 16; Wassermann test negative. Stools were negative for blood on three occasions. The urine contained a trace of bile and urobilin.

A cholecystogram, July 12, 1939, revealed a huge oval cystic area with a calcareous periphery to the right of the lumbar spine and anterior to it.

The patient refused operation. The diagnosis was hepatomegaly and a large cyst in the right upper quadrant of unknown etiology.

CASE 5: G. H., a 22-year-old white woman, was admitted to the Cook County Hospital Jan. 5, 1937, with a diagnosis of chronic cholecystitis. She gave a history of typical biliary colic six months prior to admission, with monthly recurrences. There was some tenderness in the right upper quadrant and over McBurney's point.

A Graham-Cole examination was done Jan. 19, 1937, but the gallbladder was not demonstrable, though there was an area of calcification suggesting the possibility of a calcified gallbladder. Other shadows of similar density in the region, however, made this diagnosis somewhat improbable.

At operation, Jan. 30, the gallbladder was found to be edematous but free from stones. A cholecystectomy and appendectomy were done. The gross diagnosis was cholesteatosis of the gallbladder.

CASE 6: N. H., a 40-year-old white woman, was admitted to Cook County Hospital May 24, 1938, with a diagnosis of cholelithiasis. She had suffered from gallbladder colic for 12 years and had noticed some clay-colored stools. The skin had an icteric tinge and showed excoriations from scratching. The sclerae were icteric. The thyroid gland was enlarged. Tenderness was present in both loins, referred to the epigastrium.

The basal metabolic rate was −3. The icteric index was 20.1. The urine and stools were positive for bile. The blood Kahn test was negative.

A Graham-Cole study, June 3, 1938, revealed a number of stones in the gallbladder and below these a J-shaped area of opacity. This was thought to represent calcification of the gallbladder or gallbladder dye from a previous examination.

At an exploratory examination, June 13, 1938, the common duct was found to be dilated to 1.5. cm., containing seven stones. The gallbladder was distended and contained bile but no stones. An accessory lobe of the liver was also discovered. A cholecystectomy was done; the stones in the common bile duct were removed, and a T tube inserted. Pathologic report: slight chronic cholecystitis.

DISCUSSION

The pathogenesis of calcified gallbladder is as yet not well understood. Robb (1) states that 90 per cent of the cases are accompanied by gallstones. He divides calcified gallbladders into two groups, the non-infective and the infective types. The non-infective type results from a single cholesterin stone impacted in the cystic duct, with consequent mucocele and distention followed by impaired function and atrophy in the muscular layer, fibrous replacement, and finally calcification. The infective type is due to inflammatory fibrosis which eventually terminates in calcification.

Phemister, Rewbridge, and Rudisill (11)

reported several cases in 1931 to bear out their contention that the occurrence of calcium carbonate stones or milky suspension of calcium carbonate follows obstruction of the cystic duct by stones, carcinoma, or inflammation, the calcium carbonate being produced by the gallbladder wall. Complete obstruction is not necessary but profuse secretion of mucus is a prominent factor. The calcium is found either as large stones or milk of bile due to precipitated white flakes. The density of this milky bile may simulate a gallbladder visualization after administration of a dye.

Calcification is usually demonstrable in a flat film of the abdomen. The differential diagnosis of calcareous shadows in the right upper quadrant, however, is sometimes difficult, even after all the possible methods of examination have been tried, as cholecystography, pyelography, lateral, anteroposterior, and posterior-anterior roentgenograms, and films taken after deep inspiration and expiration. Among the conditions to be considered in differential diagnosis are gallstones, renal and ureteral calculi, calcium suspensions in mucoid bile, calcified mesenteric nodes, calcified ecchinococcus cyst, calcified fecaliths in an undescended appendix, and finally, in elderly people, calcified deposits in the sternocostal cartilages.

On looking back on our films we have been impressed by the rigid and fixed appearance of the gallbladder with its peripheral calcification. Such findings should make one suspect calcification of the wall.

SUMMARY

Six cases in which calcification of the gallbladder was suspected roentgenologically are reported. In 5 of these cases operation was done and in 3 the gallbladder was found to be calcified.

Rigidity and a fixed shadow in the right upper quadrant with a calcareous periphery are important roentgenographic signs.

NOTE: Acknowledgement is hereby made to Dr. Marshall Davison, Dr. R. W. McNealy, Dr. Karl A. Meyer, and Dr. Philip Thorek, members of the Cook County Hospital Surgical Staff, for operative verification in the cases cited.

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Fig. 6. Case 3: Shadow with calcareous periphery observed in the gallbladder region during a barium meal examination.

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Changes in the Central Nervous System of Goldfish Irradiated in the Depths of a Water Phantom[1]

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THE SUITABILITY of the goldfish for the evaluation of the biological action of roentgen rays has been demonstrated in previous investigations (1). In the depths of a water phantom the lethal effect of the rays was found to be somewhat higher than was anticipated from measurements by means of the ionization chamber (2). In addition, irradiation in the depth resulted in an enhanced pigmentation of the fish. The study of this phenomenon indicates that it may be attributable to changes in the chromato-motor neural center produced by irradiation (3). This belief is substantiated by previous histologic observations on the brains of irradiated goldfish (4). The changes consisted of demyelinization, gliosis, and destruction of nerve cells, predominantly in the medulla oblongata. The severity of these changes is dependent on the dose of radiation. It is to be emphasized, however, that certain roentgen doses which did not produce pigmentation in fish irradiated on the surface of the water phantom led to that result in the depths of the phantom. For this reason it was deemed advisable to study the central nervous system of fish thus irradiated.

The entire set-up used in these experiments has been described in detail in previous papers (1, 2).

METHODS

The *radiation factors* were: (*a*) 200 kv., 30 ma., 0.5 mm. Cu and 1.0 mm. Al filter, intensity 48 r/min., H.V.L. 1.0 mm. Cu; (*b*) 200 kv., 25 ma., 0.5 mm. Cu and 3.0 mm. Al filter, intensity 58 r/min., H.V.L. 0.9 mm. Cu. The target-surface distance was 50 cm. The field measured 15 × 15 cm.

The *water phantom* measured 32 × 32 × 32 cm., thus permitting the maximum backscatter even at a depth of 10 cm.

Ionization measurements were made with the Victoreen r-meter, as previously described (1). For the evaluation of the measurements quoted in this paper, the following data obtained for radiation of H.V.L. 1.0 mm. Cu are repeated:

In air	48 r/min.
Surface	68 r/min.
Zero position of the experiment (1)	60 r/min.
At 10 cm. depth in the phantom	20.5 r/min.
Depth dose at 10 cm	34%

Histologic Technic: The nervous system of the fish was embedded in celloidin, sectioned horizontally, and stained by the myelin sheath and cresyl violet methods.

RESULTS

Histologic examination of the brains of goldfish irradiated in the depths of the water phantom revealed significant changes in the medulla oblongata. The following protocols are typical of the findings:

PROTOCOL 909: Goldfish 72B, irradiated in the water phantom at 10 cm. depth, with 3,000 r in air; estimated "body dose" about 1,000 r. Pigmentation appeared on the 13th day and the fish died on the 25th day.

Microscopic Examination: In the myelin sheath preparation, all fiber tracts of the medulla oblongata and some in other regions had a marked honeycomb appearance. This was most pronounced in the medulla oblongata. With higher magnification, extensive breaking-down of the myelin sheath fibers and swelling were observed (Fig. 2). Some of the axis cylinders had a corkscrew appearance and were swollen.

In the cresyl violet preparation, most of the nerve cells of the medulla oblongata were seen to have disappeared completely; those remaining showed loss in chromatin, vacuolization, a shadow appearance,

[1] From the Radiotherapy Department and the Neuropathological Laboratory, Montefiore Hospital for Chronic Diseases, New York City. With the aid of a grant from the Emergency Committee in Aid of Displaced Foreign Physicians. Accepted for publication in July 1941.

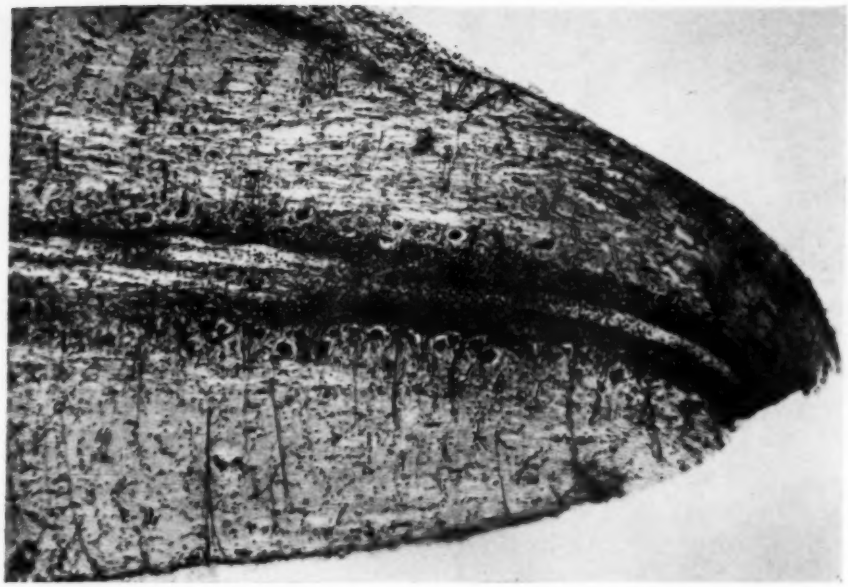

Fig. 1. Medulla oblongata of an unirradiated fish. Myelin sheath preparation. ×100.

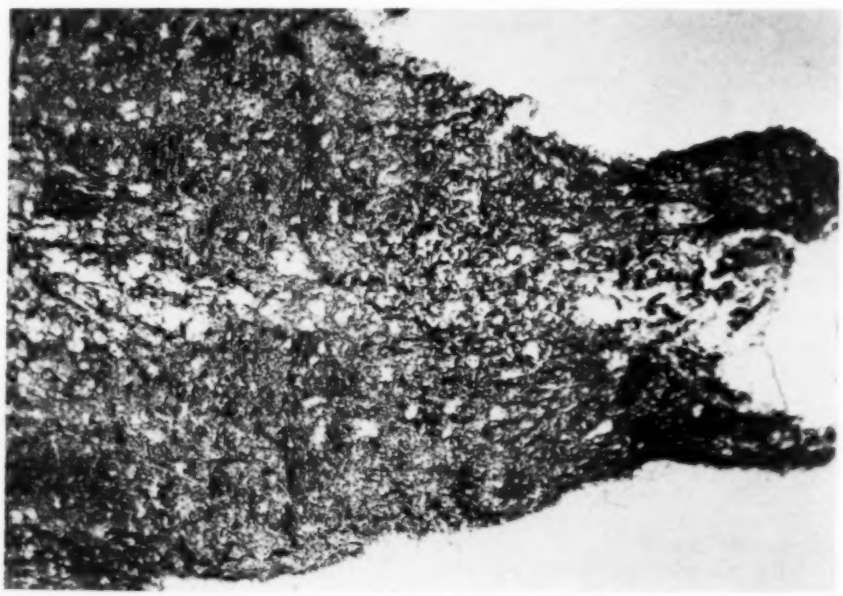

Fig. 2. Honeycomb appearance and extensive destruction of myelin sheaths of the medulla oblongata in an irradiated fish. Compare with the normal, Fig. 1.

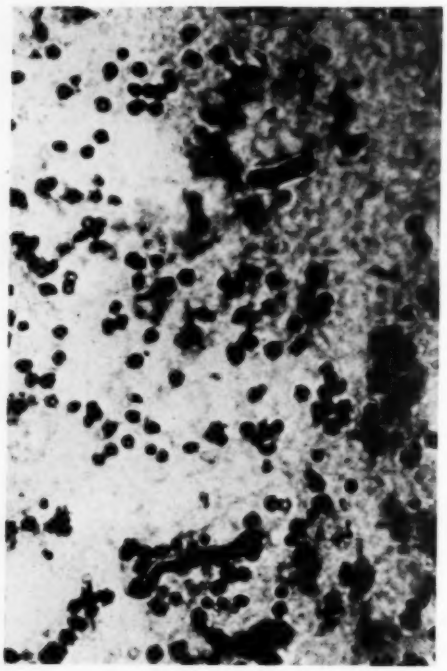

Fig. 3. Disappearance of the nerve cells, chromatolysis, shadow cell appearance, ischemia, and severe cell changes in the Nissl bodies in irradiated goldfish 72B. Cresyl violet stain. ×400.

or complete disintegration (Fig. 3). There was an increase in the glia nuclei, with swelling of some. The nerve cells of the midbrain and diencephalon showed changes somewhat similar but less extensive than those in the medulla oblongata.

Microscopic Diagnosis: Encephalomyelopathy due to irradiation.

For the purpose of comparison, the histologic appearance of the brain of a fish irradiated with a somewhat greater "body dose" on the surface of the phantom is described:

PROTOCOL 877: Goldfish 48E2, irradiated with 1,000 r in air on the surface of the water phantom, so-called zero position (1); estimated "body dose" about 1,250 r. Pigmentation appeared on the 23d day and the fish was killed on the 28th day after irradiation.

Microscopic Examination: In the myelin sheath preparation, no abnormality could be noted. In the cresyl violet preparation, the upper part of the medulla oblongata was seen to be filled with numerous glia cells, occasional extravasated red blood cells, and some fibroblastic elements; there was slight proliferation of the blood vessels; also a slight decrease in the nerve cells. Those remaining stained somewhat poorly, showed a loss in chromatin, and appeared as shadow cells. In some of the nerve cells, the nucleus was displaced to the periphery. The nerve cells of the cerebellum were poorly stained and showed loss of chromatin.

Microscopic Diagnosis: Encephalomyelopathy due to irradiation.

PROTOCOL 910: Goldfish 73B, irradiated in the water phantom at 10 cm. depth, with 1,000 r in air; estimated "body dose" about 340 r. Pigmentation appeared on the 16th day and the fish was killed on the 18th day after irradiation.

Microscopic Examination: In the myelin sheath preparation there was a slight honeycomb appearance of the fibers, especially of the medulla oblongata. Some of these were slightly swollen; complete disintegration was noted. A few axis cylinders were swollen. In the cresyl violet preparation, the nerve cells throughout, but especially those of the medulla oblongata, stained poorly but were not decreased in number when compared with other irradiated fishes. An occasional disintegrated nerve cell was noted.

Microscopic Diagnosis: Encephalomyelopathy, mild.

SUMMARY AND CONCLUSIONS

Histologic examination of the brains of goldfish irradiated in the depths of the water phantom revealed marked changes in the medulla oblongata. Protocol 909 when compared with protocol 877 discloses that, despite the almost equal time of survival of the fish, the changes in the myelin sheath preparation were more pronounced following irradiation in the depths. The same is true of the nerve cells of the medulla oblongata. In the fish irradiated with an estimated "body dose" of about 1,250 r on the surface of the water phantom there was only a slight decrease in the number of the nerve cells, while in the fish irradiated in the depths with an estimated "body dose" of about 1,000 r there was almost complete destruction of the corresponding nerve cells.

Evidently the effects of roentgen rays, as far as brain changes are concerned, are more pronounced in the depths, and greater than anticipated from the measurements by means of the ionization chamber. This is strikingly demonstrated in goldfish 73B, where an estimated "body dose" of about 340 r produced pigmentation and brain changes at 10 cm. depth, while the minimal dose re-

quired to produce pigmentation on the surface of the phantom (zero position) was found to be 800 r in air (estimated "body dose" about 1,000 r) (3). These additional observations of the increased biologic activity of roentgen rays in the depths of the water phantom are in accord with previous observations concerning the lethal effect.

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CASE REPORTS

Interstitial Calcinosis Circumscripta Associated with Scleroderma and Raynaud's Disease[1]

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Interstitial calcinosis circumscripta *per se* is not an uncommon condition, but its simultaneous association with both scleroderma and Raynaud's disease is rare. Three cases exhibiting these pathological changes will be presented here.

Interstitial calcinosis is a condition of unknown origin in which there is abnormal deposition of calcium salts in the form of multiple calcareous deposits in the soft tissues of the body, most often in the subcutaneous regions. The pathogenesis is obscure. Among the suggested etiological factors are cold, local trauma, interference with blood supply producing local vascular degeneration, disturbance in metabolism, renal disease, inadequate nutrition, hypervitaminosis D, disturbance in the local acid-alkaline equilibrium, the presence of lipolytic ferments in the subcutaneous tissues, and endocrine disease involving the thyroid and parathyroid glands.

Chemically, most of the deposits are calcium carbonate and phosphate. The condition may take either of two forms: (*a*) circumscripta, or localized, to be found mostly in adult women; (*b*) generalisata, seen most often in children. In the circumscribed form, especially in the digits, the overlying skin may break down and chalky material or concretions may exude.

Scleroderma is characterized by circum-

Fig. 1. Case 1: Multiple areas of interstitial calcinosis in the fingers.

[1] Accepted for publication in April 1940.

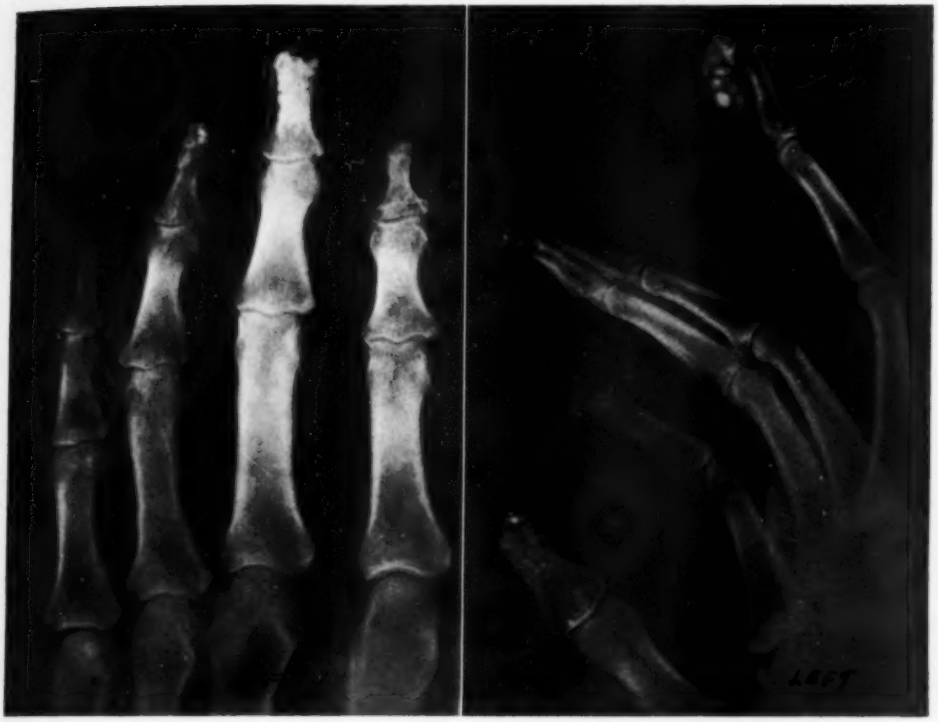

Fig. 2. Case 2: Multiple areas of interstitial calcinosis in the fingers of the left hand.

scribed or diffuse induration, rigidity, and stiffening of the integument, terminating in atrophy. The skin is thickened, tense, hard, and immovable, and feels like frozen skin, leather, or even wood. It is bound down to the structures beneath and is incapable of being pinched up. There is usually yellowish or brownish pigmentation. The etiology is unknown, but the changes are believed by some to be due to a posterior pituitary lobe dysfunction, inasmuch as improvement has been observed after administration of posterior lobe extract.

Raynaud's disease is due to a disturbance of the vasomotor innervation and is characterized by recurrent attacks of vascular spasm producing local syncope, most often in the extremities of young or middle-aged women, and generally bilateral and symmetrical. It may progress to gangrene and conical atrophy of the terminal phalanges.

The pathogenesis for the triad cannot be ascertained with certainty, as the etiology of each condition is still obscure. From an analysis of our cases, it seems plausible that the presence of Raynaud's disease predisposes to scleroderma and calcinosis. It is important to keep in mind, nevertheless, that each condition may occur independently as well as in association with the others.

CASE REPORTS

CASE 1: A female, aged 66, complained of a feeling of dryness, tightness, and a burning sensation in both hands, exaggerated in cold weather, and a recurrent ulcer at the tip of the left ring finger. Symptoms began five years earlier, with blanching of the fingers during exposure to cold. This gradually became aggravated, and two years ago an ulceration of the tip of the left ring finger was present for a few months, during which time chalky material was extruded from the wound. The clinical diagnosis was Raynaud's disease and scleroderma. Roentgen examination revealed multiple areas of interstitial calcinosis in the fingers of both hands. No pathological examination was made.

Fig. 3. Case 3: Interstitial calcinosis involving the fourth toe.

CASE 2: A female, aged 56, complained of bilateral numbness, blanching, and cyanosis of the fingers on exposure for the past thirty years. The right index finger had been amputated for gangrene twelve years earlier. Five weeks before the patient was seen she pricked the left middle finger. Infection followed and chalky material was extruded. The clinical diagnosis was scleroderma, Raynaud's disease, and possible interstitial calcinosis. Roentgen examination revealed multiple areas of interstitial calcinosis in the fingers of both hands.

Pathological examination of some of the extruded material from the left middle finger showed chronic inflammatory tissue with necrotic areas and concretions consisting of about 70 per cent calcium carbonate and 30 per cent calcium phosphate.

CASE 3: A female, aged 47, had had Raynaud's disease of both upper and lower extremities for the past eight years, with attacks of local syncope, especially in cold weather. The skin of the hands and feet was thick, tense, hard, and immovable. The clinical diagnosis was Raynaud's disease and scleroderma. Roentgen examination revealed calcareous subcutaneous material in the medial and plantar aspect of the right fourth toe near the distal phalanx. No pathological examination was made.

CONCLUSION

Three cases of interstitial calcinosis circumscripta associated with both scleroderma and Raynaud's disease have been presented.

NOTE: Thanks are due to the late Dr. I. Seth Hirsch for the use of this material.

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Supernumerary Ossicle at the Isthmus of the Neural Arch[1]

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A peculiar abnormality was discovered accidentally in two males, 32 and 58 years of age, during examinations of the urinary tract. In each case the second lumbar vertebra showed a radiolucent gap in the left isthmus (interarticular portion), that is, between the left superior and the left inferior articular processes. Above and medially to the left isthmus, separated from it by an interspace about 1 mm. wide, was a semi-globular ossicle measuring on the film 0.9 cm. in diameter. The right isthmus and the other parts of the second lumbar vertebra, as well as the other regions of the spine, were normal. There were no clinical manifestations referable to the malformation. Pain and tenderness of the back were absent, vertebral movements were free, and there were no signs or symptoms of radicular neuritis. Except for a brief reference in a previous paper (3), the abnormality seems to have not yet been described.

It is known that radiolucent gaps in the neural arch and its processes correspond to persistent epiphyseal cartilages between bones which develop from distinct ossification centers (1, 2, 5). In general, each articular process has one ossification center for its main part, and sometimes a second one at its tip. In most instances, therefore, each articular segment (which consists of the superior articular process, the isthmus, and the inferior articular process) has two constant and two inconstant ossification centers. If the bones arising from these

[1] Accepted for publication in August 1941.

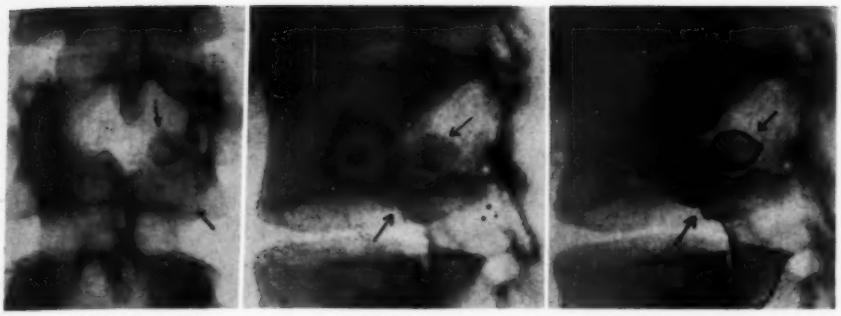

Fig. 1. Roentgenograms in anteroposterior and oblique projections, and retraced roentgenogram, of the second lumbar vertebra of a male aged 32 years, showing gap through the left isthmus (lower arrows) and supernumerary ossicle (upper arrows).

Fig. 2. Anteroposterior and oblique roentgenograms showing second lumbar vertebra of a male aged 58 years. The stippled area in the retraced films corresponds to the ossicle. Note the great similarity of the findings to those shown in Fig. 1.

Fig. 3. Vertebral movements in patient of Fig. 2. Normal range of flexibility of the lumbar spine.

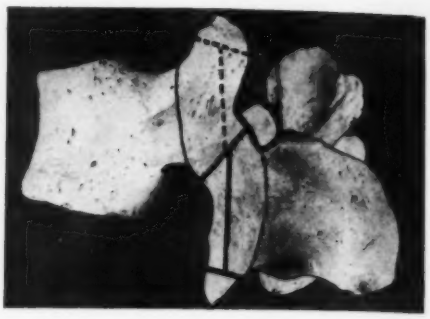

Fig. 4. Retraced photograph of a lumbar vertebra, in the oblique position, corresponding to the radiographic projection used for demonstration of the lumbar articular processes. Each articular process may have 3 ossification centers, and there may be an additional center at the isthmus. Hence 7 bones, separated by radiolucent gaps, may be present in an articular segment. In most cases, however, these gaps are confined to the inferior articular processes and the isthmus.

centers fail to unite, the cartilaginous layers between them are seen roentgenographically as radiolucent gaps.

Additional centers of ossification seem occasionally to exist. According to previous observations, a longitudinal gap may extend from the isthmus through the articular process, dividing the latter into halves (4). This indicates that each articular process may have three ossification centers: two in its main part, one at its tip. Together with the ossicle at the isthmus here recorded, the number of separate bones in each articular segment may then total seven, instead of four, as hitherto assumed, and the number of radiolucent gaps may be correspondingly great. Both the longitudinal gaps and those at the tip are more common in the inferior than in the superior articular processes, and much more frequent in the lumbar spine than in other sections.

The existence of these additional ossification centers should be borne in mind when differentiating traumatic lesions from irrelevant developmental abnormalities of the vertebrae.

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Aeroesophography in Congenital Atresia of the Esophagus[1]

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In a recent communication (1) we suggested aeroesophography as a simple roentgenographic procedure to establish the diagnosis of congenital atresia of the esophagus without the use of a liquid contrast medium. We postulated that air introduced into the esophagus through a catheter would clearly outline the upper segment in cases of atresia, thus permitting a definite diagnosis to be made. Since then we have had the opportunity of employing this method with complete success.

[1] From the Department of Pediatrics, R. A. Benson, M.D., Director, and the Department of Radiology, T. B. Weinberg, M.D., Director, Metropolitan Hospital, New York City. Accepted for publication in March 1942.

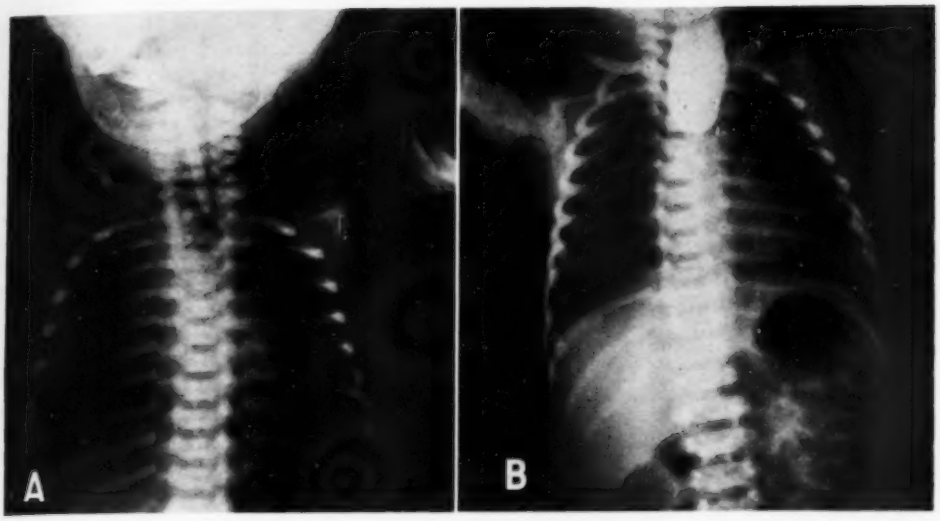

Fig. 1. The upper esophageal segment, outlined by injected air (A) and by diodrast (B). Anteroposterior views.

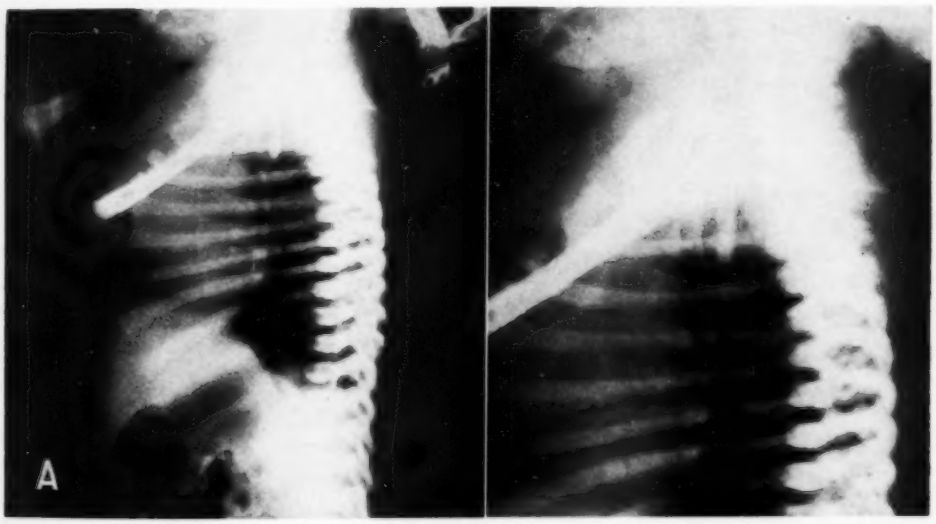

Fig. 2. Lateral views demonstrating the upper and lower esophageal segments outlined by air. The tracheo-esophageal fistula is visible. A. Untouched reproduction. B. Retouched reproduction.

E. H., a 36-hour-old infant, was referred for roentgen studies with a clinical diagnosis of congenital atresia of the esophagus with tracheo-esophageal fistula. The clinical picture was typical of this condition. On the night of delivery the only unusual feature noted was the presence of an excessive amount of mucus in the pharynx. All efforts at feeding on the following day resulted in regurgitation of the ingested milk through the mouth and nose, and in respiratory difficulty. A gavage feeding was attempted but the catheter could not be passed beyond the upper esophagus.

Following the introduction of a soft rubber catheter into the esophagus, roentgenoscopic examination showed the presence of an apparent obstruction at the level of the third dorsal vertebra. The catheter could not be passed beyond this point. A small bulb syringe was then attached to the catheter and

a few cubic centimeters of air were injected. The air column also failed to pass beyond the third dorsal vertebra, and outlined a somewhat dilated blind sac—the upper esophageal segment. The injected air provided adequate contrast for clear demonstration of the atresia. It was not found necessary to employ a Trendelenburg position.

Roentgenograms illustrating the procedure were obtained by repeating the air injection (Figs. 1 and 2). The upper esophagus was outlined as a smooth, somewhat dilated cul de sac. The lower esophagus in this instance was also clearly demonstrable as an airway leading from the trachea at the level of the second dorsal vertebra to the stomach. There was a considerable degree of gaseous distention of the gastro-intestinal tract.

The roentgen studies clearly established the diagnosis of congenital atresia of the esophagus and in this case also accurately localized the site of the tracheo-esophageal fistula without the use of a liquid contrast medium. To prove further that air is completely satisfactory for the demonstration of the blind upper segment, a film was taken following the instillation of a few cubic centimeters of 35 per cent diodrast but this gave no additional information.

The findings at operation were exactly as demonstrated roentgenographically. The lower esophageal segment opened directly into the trachea just above the bifurcation. The upper esophagus terminated in a blind pouch at a slightly lower level. An attempt was made to close off the communication between the lower esophagus and the trachea and to mobilize both segments of the esophagus sufficiently to bring them into the field of operation. The condition of the infant, unfortunately, did not permit such an extensive procedure, and death occurred a few hours after the operation.

The autopsy subsequently performed gave no additional relevant information. It was demonstrated grossly and histologically that the lower esophagus was intimately fused with the trachea.

SUMMARY

A case of congenital atresia of the esophagus is presented. A new radiographic procedure—aeroesophography—was employed to establish the diagnosis, rendering the use of a liquid contrast medium unnecessary.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Malpractice Suits Against Radiologists: Prophylaxis

A malpractice suit is a disagreeable experience. It may involve a younger and relatively inexperienced radiologist, because of his youth and his lack of experience, or it may involve an older radiologist because of his experience, and because he may have accumulated some funds which a lawyer and his client want to attach. The carrying of malpractice insurance is no guarantee against suits. In fact, it may be one of the incentives, since the plaintiff or the attorney may assume that "it does the doctor no harm and the insurance company can well afford to pay." Every physician, however, should carry such insurance. He may be involved in a malpractice suit even in the treatment of a free hospital patient. The suit is entered against the physician and not against the hospital.

The cause of a malpractice suit may be at least any one of the following:

(1) One cause, and one definite liability, is carelessness or negligence. If the attending physician is careless or negligent and damage results to the patient, the jury and the Court will render a verdict against him. The radiologist is responsible for any negligence on the part of his assistants, his technicians, or anyone in his employ. Routine discipline, care, and attention to all possible details at all times will help to eliminate this cause. Negligence may involve a *loose or lax high tension wire*, which comes too close to the patient's body, resulting in an electric burn. The modern shock-proof equipment will usually exclude this danger, but when shock-proof equipment is not available great care must be observed.

(2) A second cause is the *omission of a filter*, when the dosage is calculated on the basis of a filter. (*a*) This may be avoided in part by signal lights or a balance of the filter with the control switch, as provided for in some equipment. This prevents any current passing when the signal and the filter are not the same. (*b*) With older equipment having no safety device, one can divide the anode wire and attach a ring on each section which can be connected only by a double hook to which is attached a cord with an indicator leading to the proper filter. This demands detailed attention at each treatment. The filter indicator can be seen from the window. (*c*) The control stand may be connected so that it will ring a bell when no filter is present, or so that it will make circuit through a red light. (*d*) In my institute two people are required to check distance and filter before turning on the current. (*e*) Finally, it is my custom to have the current turned on for each x-ray treatment for only a minute, when the filter and all other details are checked a second time.

(3) *Damage may result from incompetency.* This may involve excessive dosage in therapy or excessive exposure during fluoroscopy. Fluoroscopy with resultant damage to the soft tissues has been the source of most malpractice suits brought against radiologists. This may be avoided by various methods fully described in the literature. Probably the most important single factor in avoiding damage from fluoroscopy is that the radiologist subject his eyes to darkness for a period of at least seven minutes, or for really satisfactory work twenty minutes, before beginning

fluoroscopy. The longer the fluoroscopist can remain in darkness, the better will be his vision, the shorter the required exposure, and the less damage as a result. If one remains in artificial light and wears red glasses while doing routine work, this waiting time can be slightly shortened. (Read Chamberlain's Carman Lecture on "Fluoroscopes and Fluoroscopy" published in RADIOLOGY **38:** 383, April 1942.)

A second precaution against damage to the patient during fluoroscopy is provided by the use of 1 or 2 mm. aluminum filtration. This, at least, gives some additional protection to the skin and subcutaneous tissues as compared with unfiltered fluoroscopic effects. A third precaution consists in keeping the field of vision as small as possible to observe the essential part of the organ under observation, and a fourth in employing interval fluoroscopy, which will save much damage. Finally, the more expert the observer, the less the time needed to reach conclusions as to the pathological condition present, and, therefore, the less the actual exposure or possible damage of the tissues.

The radiologist is almost certain to be held responsible for the work of the technician. Wanwig says: "An examination of 166 roentgen-ray cases by the legal counsel of the New York State Society shows that 40 per cent of them grew out of treatments given by technicians." It is my custom to set up every treatment case myself or, when this is not possible, to have it set up by my assistant, a trained radiologist. This I believe will produce the best therapeutic results and will help to avoid damage suits.

More real damage is produced by the untrained, inexperienced physician (general practitioner) than in any other way. For this reason, there has been a tendency to discourage general practitioners from attempting fluoroscopic or therapeutic work. Yet, unfortunately the general practitioner thinks that he can do roentgenoscopy (fluoroscopy) even if he cannot do any roentgenography. Salesmen encourage the belief that fluoroscopy is a simple procedure. As a result, it is the untrained physician, rather than the trained radiologist, who usually damages himself and his patient. The inexperienced man tries to see the details better by increasing the amount of current and by prolonging the examination. This occurs particularly in setting fractures. I would like to repeat the counsel given by Chamberlain in his Carman Lecture, that when ractures are being set under fluoroscopic guidance, the current should be turned off entirely during manipulations. The fluoroscopic observation should be made only at intervals, when from clinical observation under weak red light the fracture seems to be in good apposition, and then the affected part alone should be brought into the field.

There is at present no known method of eliminating all secondary radiation during fluoroscopy. In the future we may find that even this secondary radiation is damaging; up to the present time, I know of no damage that has resulted purely from secondary radiation, and I believe there are no damage suits based on this type of injury.

I have considered first of all the malpractice suits which may have an actual foundation in damage done to the patient. There are probably even more malpractice suits originating from an *assumed damage* or, at least, damage for which the radiologist is in no way responsible. *In modern therapy, in many instances, it is essential to carry irradiation to the extent of producing redness or desquamation of the surface skin.* In other words, one must frequently carry the treatment to the tolerance dose, which means the greatest dose possible from which the uninvolved tissues can recover, or at least be restored practically to normal. This applies especially to radiation therapy of deep-seated malignant growths, and especially the more resistant type of malignant neoplasm. Damage suits from this cause can usually be prevented by explaining to the patient or to members of the family, in the presence of a reliable witness, that such an effect is likely to be produced and is desirable, as the lesser of two evils.

If, under such circumstances, the patient refuses to take these risks, then it is advisable for the radiologist to refuse to undertake the treatment of the case. One must not, of course, guarantee a cure even when such heavy irradiation is used. It is fear of malpractice suits from this cause that leads many radiologists to treat patients insufficiently to get them well. The treatment is then dragged along with protracted fractional doses, none of which in itself produces damage; the tumor tissue develops a resistance, and in the end, failure results. Damage to normal tissue can occur from the accumulation of small doses without ever producing redness of the skin. Here again experience and knowledge count for much both in the management of the patient and the avoidance of damage suits. A careful clinical localization of the extent of the disease, and careful cross-firing onto this disease or deep-seated lesion, keeping the fields as small as possible, will help to preserve the overlying normal tissues. This requires a great deal of skill, and, I believe, generally cannot be delegated to a technician, unless he is so well educated and trained in pathology and anatomy that he knows as much as the radiologist is expected to know.

Another cause of dissatisfaction, and therefore of malpractice suits, is the *false impression given to the patient or the family at the beginning of treatment.* It is well known that not all patients get well and that there is a very considerable variation in the result obtained. Even those who recover from the disease for which they are treated may not have their tissues restored to a perfect normal. A frank discussion of the possible or probable outcome with the patient or some member of the family in the presence of witnesses is an important precaution. For example, if the records show, or the radiologist's experience indicates, that 80 per cent of those with the particular disease that he is treating recover, he has a right to say so, but he must not lose sight of the fact that there are 20 per cent who do not recover, or whose recovery is only partial, leaving certain defects or dissatisfaction. On the other hand, if one is dealing, for example, with advanced carcinoma of the uterus, with not more than a 1 or 2 per cent chance of recovery, the family should be told the facts. This does not mean that the treatment is not justifiable, for it may be indicated for the arrest of hemorrhage, for the increased temporary comfort of the patient, or even for the sake of boosting her courage and morale. When such treatment is undertaken, however, it should be done with the full knowledge of the attending physician and of some responsible member of the family. It is true that one cannot always discuss these serious cases and the likelihood of an unfavorable outcome with the patient, but the responsible person of the family should know the facts.

It is not entirely fair to assume that every radiologist will obtain the results that are reported by some man with extensive experience who has prepared a series of statistics showing a high percentage of cures. The man who does not have that experience has no right to assume, or leave the patient or the family under the impression, that he is going to obtain the same proportion of good results. On the other hand, it is possible for a younger and inexperienced man to do better work, by giving the greatest possible attention to details, than an older, more experienced man who is relatively careless or who turns his work over to technicians.

Another cause of malpractice suits is the desire *to escape the payment of the bill for services rendered.* This is probably the most difficult of all problems for the radiologist, who aims to follow the principle of all physicians, to give the best possible service, hoping to be paid for his services, either during the time of their being rendered or on their completion. Approximately two-thirds of the radiologist's fee as a private practitioner is involved in overhead expense, and failure to pay him, therefore, means a very real loss. On the other hand, if he treats the patient and the results from the treatment are not satisfactory, which means that the patient

either did not get well, or that the effect was not the ideal and perfect one which the patient had hoped to obtain, there may then be an unwillingness or perhaps inability to pay the bill. If unsatisfactory results have been obtained, or especially if any damage has been done to the tissues, the patient or his family becomes an easy prey to some member of the legal profession who hopes to get a settlement out of Court, gain a fee for himself, and at the same time let the patient escape paying his bill.

If we as radiologists make sure that we are not at fault in rendering service, we should not submit to any such holdup but should contest the suit for the sake of the general good of the profession. In other words, we should not submit to blackmail! This difficulty about getting bills paid, which is the cause of some malpractice suits, can be avoided by having a definite understanding at the time of beginning treatment, or by having payments made in cash or at least requiring payment during the time of rendering service. This, I admit, is a disagreeable part of the practice of medicine, and all of us wish it could be avoided. Some radiologists turn this whole matter of fee and its collection over to a secretary, who is probably less considerate. Such a procedure sometimes results in harshness and dissatisfaction, and we are not able to live up to our ideal in the practice of medicine, to "render service without regard to pay."

By giving the greatest possible attention to these precautionary measures, most malpractice suits can be prevented. The teaching of all physicians—and under the present consideration especially all radiologists—to avoid comment or criticism or the expression of opinion concerning another physician's work without knowing all the details and circumstances, will be of further help. Compliance with a request to see a patient who is alleged to have been damaged is, I think, a means of protecting a colleague, but whenever possible the patient should be seen together with the attending radiologist, or, at least, his diagnosis and details concerning the treatment should be obtained. One cannot give an honest opinion in any other way. A convincing friendly colleague can often abort a threatened suit.

GEORGE E. PFAHLER, M.D.

Philadelphia, Penna.

ANNUAL MEETING RADIOLOGICAL SOCIETY OF NORTH AMERICA

The attention of all radiologists, and especially members of the Radiological Society of North America, is called to the Annual Meeting, which will be held at the Drake Hotel, Chicago, Nov. 30 to Dec. 4, 1942. In spite of war conditions the meeting promises to be a most profitable one. In addition to the regular sessions, the usual Refresher Series for Post Graduate Instruction will be held. Further details will appear in coming issues of RADIOLOGY.

MIDSUMMER RADIOLOGICAL CONFERENCE POSTPONED

Because so many of its members have been called into the National Service, the Rocky Mountain Medical Society has this year postponed its Midsummer Radiological Conference, which is usually held in Denver in July or August.

AMERICAN CONGRESS OF PHYSICAL THERAPY

The Twenty-first Annual Scientific and Clinical Session and Annual Instruction Course of the American Congress of Physical Therapy will be held Sept. 9–12, at the Hotel William Penn, Pittsburgh, Penna. Information concerning the program may be obtained from the American Congress of Physical Therapy, 30 North Michigan Ave., Chicago, Illinois.

INDIANA ROENTGEN SOCIETY

The fifteenth annual meeting of the Indiana Roentgen Society was held at the Indianapolis Athletic Club, May 24, 1942. Dr. Wemple Dodds of Crawfordsville was named president-elect, Dr. Cecil Wright, of Anderson, vice-president, and Dr. Harold C. Ochsner, of Indianapolis, secretary-treasurer. Interesting cases were presented by members of the Society for discussion and Dr. Lawrence Reynolds of Detroit gave an instructive talk on "Roentgen Evidence of Injury to the Internal Semilunar Cartilage." The meeting was attended by a number of local orthopedists and members of the staff of Billings General Hospital at Fort Harrison.

NEW YORK ROENTGEN SOCIETY

At its meeting on May 18 the New York Roentgen Society elected the following officers for the ensuing year: President, Dr. Roy D. Duckworth, White Plains; Vice-President, Dr. Paul C. Swenson, New York City; Secretary, Dr. Maurice Pomeranz, New York City; Treasurer, Dr. Haig H. Kasabach, New York City.

Book Review

ÜBER DIE BEDEUTING DER ROENTGENUNTERSUCHUNG FUER DIE KARDIOLOGIE, SPEZIELL MIT RUECKSICHT AUF DIE BEDEUTUNG DER HERZVERGROESSERUNG. [The Value of Roentgen Studies in Cardiology, with Special Observations on the Significance of Cardiac Enlargements]. By TORFINN DENSTAD. Supplement XL of Acta Radiologica. A monograph containing 80 pages. Published by P. A. Norstedt & Son, Stockholm, 1941.

This study is based on clinical and roentgenological examinations of over 200 cases of heart disease. The author considers the most important feature of cardiac roentgenology to be the determination of exact heart size. He believes that the transverse diameter of the heart shadow correlated with the chest diameter (cardio-thoracic ratio), together with the longitudinal diameter as determined by teleroentgenograms, will portray with sufficient accuracy the true size of the heart.

By comparing the values obtained with tables of the average normal measurements, the author classifies his cases as mild, moderate, and marked cardiac enlargements. Numerous tables are given for specific types of heart disease, such as syphilitic, rheumatic, and degenerative. The tables contain the measured size of the heart, clinical symptomatology, blood pressure, and the electrocardiographic findings.

As a result of a critical analysis of his material the author concludes that the heart size, as expressed by the cardio-thoracic ratio, gives a fair clue to the condition of the heart muscle and thus to the prognosis of any case. The most important information is furnished by the x-ray examination in those cases where an enlargement of the heart exists without any clinical symptoms, especially in the degenerative and syphilitic heart lesions, but also in cases of mitral disease with only slight evidence of decompensation. In cases of acute carditis the enlarged heart shadow may present the only sign of disease; a progressive enlargement the only sign of progression of the process. The author emphasizes that in cases of hypertensive heart disease, the exact cardiac measurements may yield more important information than electrocardiography or measurement of the blood pressure.

There is doubt in the mind of the reviewer whether such a classification of the degree of cardiac enlargement by mathematically expressed measurements gives more reliable information than may be gained by casual estimates, especially if the heart shape is also considered. The more complex criteria for exact heart size determination, as age, sex, weight, phase of respiration, phase of heart action, surface action, and volume determination, are not here considered.

J. NEWTON SISK[1]

1890–1942

Dr. J. Newton Sisk, radiologist of the Jackson Clinic and Methodist Hospital, Madison, Wisconsin, died on April 25, 1942, of a cerebral hemorrhage.

Dr. Sisk was born in Weatherford, Texas, in 1890 and was graduated from the Baylor University College of Medicine, Dallas, in 1921. He assumed the position of roentgenologist at the Jackson Clinic

J. NEWTON SISK

in 1923 and won recognition for his unusual diagnostic ability and exceptional skill in this field. He took an active part in the affairs of the Dane County and the State Medical Society of Wisconsin and by the latter was elected speaker of the House of Delegates in 1939 and 1940. While his impaired health prevented him from performing actively the duties of this position, he was presented with a gavel symbolic of the office.

[1] RADIOLOGY is indebted to the Jackson Clinic Bulletin for this tribute to Dr. Sisk.

The following tribute was paid to Dr. Sisk at the 1941 Annual Meeting of the House of Delegates by Dr. R. M. Kurten, speaker of the House: "The members of the House have often been impressed by the unselfish devotion of many members of the Society who have served their profession in exceptional ways, and to an extent that could only be self-imposed . . . . Tonight I have the privilege of bringing Dr. J. Newton Sisk before this body, and expressing to him, in its behalf, its appreciation for many a task well done."

Dr. Sisk was a member of the American Medical Association, the Radiological Society of North America, the American College of Radiology, and a diplomate of the American Board of Radiology.

To those who knew him intimately, Newton Sisk was a dynamic and independent thinker willing to uphold a well grounded opinion irrespective of the opinion of others. Aggressive, sometimes impetuous, he minced no words, for weakness and lack of courage were unknown to him. He was a true scientist of whom no one questioned his intelligent honesty. As a friend he was generous to a fault, and the center of congenial companionship. His going leaves us with a deep sense of sorrow and unmitigated loss.

Prof. John D. Hicks, of the University of Wisconsin, writes: "Dr. Sisk was an ever loyal friend, always on hand in case of trouble, and always ready to defend his friends against anyone who dared disparage them. He was over-generous, and gave away both medical advice and worldly goods without so much as thinking of counting the cost. He loved to show hospitality not only to his own friends but even to his friends' friends whom he always made to feel at home.

"He had a fine mind, not only for the technical field in which he was so proficient, but in a great variety of other fields. He was well read, especially in history and literature, and never failed to hold his own in the verbal combats he so delighted to provoke. He possessed unusual mechanical skill, and spent many happy hours with the fine assortment of tools he kept in his basement workroom.

"Dr. Sisk was as devoted to his principles as to his friends. He had his convictions and stood firmly by them in deed no less than in word. He was public minded, served for years on the Shorewood Hills village board, took an intense interest in the public schools, voted regularly and with enthusiasm, whether pro or con.

"Dr. Sisk's great shortcoming was the thing that made him so beloved. He lived too hard. From his youth up he got too excited about the causes he championed, too intense about the work he had to do. But while he lived, he lived. In his brief fifty-one years he got more out of life and put more

into it than most people could hope for with a span of life twenty years longer. The world is made poorer by his death, but it is much the richer because he lived."

FREDERICK PAGE BOSWELL

1888–1942

Dr. Frederick Page Boswell of Montgomery, Ala., a member of the Radiological Society of North America and a diplomate of the American Board of Radiology, died early this year. Dr. Boswell was graduated from the University of Alabama School of Medicine in 1911. He was roentgenologist to St. Margaret's Hospital, Montgomery.

HAROLD G. F. EDWARDS

1888–1942

Dr. Harold G. F. Edwards, of Shreveport, La., died early in April of this year. Dr. Edwards was born in Abbeville, La., in 1888 and was graduated from the Tulane University of Louisiana School of Medicine in 1911. He was director of the Roentgen Ray Department and Clinical Director of the Tumor Clinic of the Shreveport Charity Hospital. Dr. Edwards was a diplomate of the American Board of Radiology and a member of the Radiological Society of North America, the American Roentgen-Ray Society, the American Radium Society, the American Association for Cancer Research, and the American College of Physicians.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Earl R. Miller, M.D., University of California Hospital. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (University of California Medical School); second six months at Lane Hall (Stanford University School of Medicine).

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Walter A. Weed, M.D., 204 Exchange Building, Orlando

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, Robert C. Pendergrass, M.D., Prather Clinic Bldg., Americus. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, W. R. Harwell, M.D. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

The Kansas City Radiological Society.—Secretary, P. E. Hiebert, M.D., 907 North Seventh St., Kansas City, Kansas. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Wilbur K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, D. A. Dowell, M.D., 816 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Maurice Pomeranz, M.D., 1120 Park Ave., New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, J. O. Newton, M.D., 13921 Terrace Road, East Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Justin E. McCarthy, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Bartc Young, M.D., Temple University Hospital, Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, L. W. Baird, M.D., Scott and White Hospital, Temple.

VIRGINIA

Virginia Radiological Society.—Secretary, Charles H. Peterson, M.D., 603 Medical Arts Bldg., Roanoke.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Section on Radiology, Canadian Medical Association.—Secretary, W. J. Cryderman, M.D., Medical Arts Bldg., Toronto.

Section on Radiology, Ontario Medical Association.—Secretary, W. J. Cryderman, M.D., 474 Glenlake Avenue, Toronto.

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Leptomeningeal Cysts from a Roentgenological Viewpoint. C. W. Schwartz. Am. J. Roentgenol. **46:** 160–165, August 1941.

Cysts of the leptomeninx, or arachnoid, may be produced by injury or, in all probability, as a sequel to meningitis or meningo-encephalitis. Only those cysts occurring over the cortex can be expected to produce changes in the skull which can be recognized and considered as reasonably characteristic. It usually takes from two to four years for the production of such recognizable changes, consisting in areas of bone atrophy of varying degree, having rather irregular, scalloped, or rounded margins surrounding or close to an old fracture. Irregular areas of increased density may sometimes be noted.

The clinical symptoms depend on the location of the lesion and may suggest a tumor.

S. M. ATKINS, M.D.

THE CHEST

Technic of Bronchography and a System of Bronchial Nomenclature. R. Adams and L. F. Davenport. J. A. M. A. **118:** 111–116, Jan. 10, 1942.

An accurate, complete, intelligently made bronchogram can reasonably be expected of anyone who undertakes the procedure. Every bronchial segment should be visualized in order that the extent of the disease may be established and a proper plan of therapy instituted. Especially is this important if surgery is indicated.

A small dose of pentobarbital one hour beforehand helps allay nervousness and acts as a specific prophylactic antidote to cocaine hypersensitivity. A dose of morphine sulfate one-half hour beforehand is useful for its effect in controlling the cough reflex. Atropine is given with the morphine to decrease secretion. Three hours before injection of the contrast medium the bronchi are emptied as much as possible by postural drainage and voluntary coughing. Fluids are restricted until three hours after the injection. The oil should be introduced and the x-ray films taken in the same room to conserve time and motion.

Good anesthesia is prerequisite to good bronchography. With the patient in a sitting position, the pharynx is sprayed with 3 c.c. of 4 per cent cocaine, each of the piriform sinuses and the epiglottis are swabbed with 1 c.c., and 5 per cent larocaine (5 c.c.) is injected down the trachea.

A urethral catheter is threaded on a metal stylet, bent to an 80-degree angle 3 inches from the distal end. With the aid of the laryngeal mirror the catheter is introduced into the trachea and the stylet is removed. The catheter should be about 2 inches above the carina. The patient closes his lips on the catheter and sits on a flat-top table adjacent to an x-ray tube stand, where the injection is done. The iodized oil is injected at room temperature, as this minimizes alveolar filling. Ten c.c. of oil are injected in a time interval of seven minutes, during which the patient assumes various positions so as to allow filling of the bronchi in all sections of the lung of one side. The opposite side is then filled in the same manner. Drawings illustrate the positions used.

Lateral views are obtained while the patient is on the table, and postero-anterior and right and left anterior oblique views are made in the erect position. After the films are found to be satisfactory, the patient is placed in the head-down position and urged to cough up the iodized oil.

Cases of active pulmonary tuberculosis, acute lung abscess, intrinsic asthma, and suspected tumor should not be investigated by means of iodized oil unless exceptional reasons exist for the procedure.

In the belief that a simple terminology is a primary condition for successful study of the air passages, the authors propose a classification designed to meet the practical needs of internists, radiologists, bronchologists, and surgeons. Diagrams from tracings of actual bronchograms are used. The term primary bronchus is suggested for the two divisions of the trachea as preferable to main, major, arterial, or trunk. The classification according to lobes is the usually accepted one.

Various portions of the lung have special significance both pathologically and surgically. Pulmonary tuberculosis occurs predominantly in the apical division. The lingula is involved in bronchiectasis in 80 per cent of the left lower lobe cases. The dorsal division of the lower lobe is a frequent site of putrid lung abscess. Involvement of this division by bronchiectasis is rare, even though the predominant site of the latter is in the contiguous basal division of the lower lobe. The term division is proposed to indicate these surgically and pathologically important anatomic portions of lobes. Thus, the left upper lobe has apical and lingular divisions and each lower lobe has dorsal and basal divisions. The right upper lobe may be thought of, if desired, as having only an apical division, while the right middle lobe possesses no divisional substructure.

The bronchopulmonary segment is the smallest unit of lung tissue of practical diagnostic or therapeutic importance. Dissections and injections have shown these segments, surrounded by planes of avascular tissue, uncrossed by bronchi or blood vessels beyond the hilus, with remarkable constancy in the periphery of the lungs. The right upper lobe, for example, is considered to consist of four segments—anterosuperior, posterosuperior, anteroinferior, and lateral. Detailed description of these segments is given in the text, and line drawings depict their locations on the surface of the lungs. In the hilus the segmental integrity is lost in a maze of interlacing bronchi, arteries, and veins, varying from case to case and thus far defying exact classification. CLARENCE E. WEAVER, M.D.

Linear Shadows in the Lung (Interlobar Pleuritis, Atelectasis, and Healed Infarction). F. Fleischner, A. O. Hampton, and B. Castleman. Am. J. Roentgenol. **46:** 610–618, November 1941.

Unless the pathologist is forewarned, lesions producing linear shadows in the pulmonary roentgenogram may easily be overlooked or dismissed as of no great importance, postmortem. Three conditions are considered which produce these linear shadows: interlobular pleuritis, atelectasis, and healed pulmonary infarcts.

Interlobular pleuritis, as is well known, is demonstrable as a widening of the thin linear shadow which represents the normal interlobular pleura. In the presence of large amounts of interlobular exudate, band or spindle-shaped shadows may be obtained.

Atelectasis is represented by plate-like or band-shaped shadows, usually seen in the lower lung fields. These vary from thin lines which are barely visible to shadows about 5 mm. in thickness. Band-shaped foci of atelectasis always extend to a pleural surface. They do not cross interlobar fissures. Pathologically these atelectatic areas appear on the pleura as grayish-blue, depressed, horizontal, linear bands of non-aerated or partially aerated lung.

The characteristic picture of a healed pulmonary infarct is a dense single line running in almost any direction but always reaching the pleural surface. Here it may end at a nodular rounded shadow whose convexity faces the linear shadow, or there may be, instead, a

V-shaped thickening or retraction of the pleura. The majority of healed infarcts occur in the lower lobes. The lung is usually reduced in size due to the scarring. The authors discussed the subject of pulmonary infarcts in fuller detail in an earlier paper (Am. J. Roentgenol. **43:** 305, 1940. Abst. in Radiology **36:** 510, 1941).

The pathogenesis and differential diagnosis of linear lung shadows are discussed and numerous illustrations are presented. S. M. ATKINS, M.D.

Roentgenoscopy of the Lungs: Its Adequacy as Determined by Spot Roentgenography. R. H. Stiehm. Am. Rev. Tuberc. **45:** 15–35, January 1942.

Stiehm presents evidence to show that proper fluoroscopic examination of the chest may reveal small pulmonary infiltrates which cannot be seen in routine roentgenograms. In order to record the observations seen on the screen, a spot film device is used so that small films of the suspected area can be made without changing the position of the patient. Illustrative cases are presented in which the spot films demonstrated small but clinically significant lesions that, in ordinary roentgenograms, were obscured by overlying bony structures. The magnified distortion due to the close target film distance in fluoroscopy and fluoroscopic roentgenography is one factor which favors the detection of these small lesions. Another factor is the ability to move bony structures out of the way and to bring the lesion into the plane in which it casts the densest shadow. The author expresses the opinion that roentgenoscopy of the chest will some day be regarded as the most accurate method for finding small infiltrates in the lungs. Its use will be limited primarily to those who employ it repeatedly and become proficient by experience.

LESTER W. PAUL, M.D.

Roentgen Diagnosis of the Primary Tuberculous Infection. C. C. Birkelo. J. A. M. A. **118:** 350–353, Jan. 31, 1942.

The first site of tuberculous infection in the lungs is the alveolar spaces. These become filled with phagocytes, and small areas of consolidation are formed. The infection early extends along the lymphatic channels into the regional lymph nodes. Soon a sensitivity toward the tubercle bacillus develops in the body and an attempt to focalize and limit the infection occurs. It is because of this sensitivity that we are able to obtain the tuberculin reaction. The parenchymal lesion, when small, will soon become invisible in the roentgenogram, but when it is large many months may be required before it clears. Whether large or small, these lesions often caseate and, when caseation occurs, calcium deposits are common. These calcium deposits were first described by Ghon and have since been called by his name—the Ghon foci.

The primary infection is more often discovered because of lymph node enlargement. Not infrequently the nodes become so greatly enlarged that they occlude a large main stem bronchus and cause atelectasis. They may also ulcerate or rupture into a bronchus or into the blood stream. The primary infection occasionally occurs in the adult.

The most common location of the primary lesion appears to be at the middle or basal portion of either lung, but it may also be found at the apices. In the reinfection type of tuberculosis the upper half of the lung is by far the most common site; in this type of the disease purely basal lesions occur in about 2 per cent of the cases.

One or more groups of enlarged lymph nodes may be present but they are commonly unilateral. They are often extensively enlarged and out of proportion to clinical findings and symptoms.

A number of conditions require differentiation from tuberculosis. Hodgkin's disease also exhibits lymph node enlargement, but this is usually bilateral and of nearly equal extent on the two sides, and displays a tendency to progress rather than retrogress. In lung abscess lymph node enlargement is generally lacking, and serial roentgenograms will show excavation in a short time. The outstanding roentgen finding in cystic disease is localized or generalized fibrosis with areas of rarefaction, sometimes resembling excavation. There is rarely, however, any lymph node enlargement. The most common cause of hemoptysis in the child and young adult is bronchiectasis. In these cases there is a history of repeated attacks of pneumonia and influenza. Colds will last for weeks in a bronchiectatic child. The x-ray findings are nearly always at the base of either lung and lymph node enlargement is infrequent. Atelectasis may be caused by lymph node enlargement which compresses a main stem bronchus. Non-opaque foreign bodies may also produce bronchial occlusion.

In the discussion of this paper, Dr. Ralph S. Bromer recommended the use of oblique views for demonstrating enlarged lymph nodes at the bifurcation of the trachea and the paratracheal groups.

CLARENCE E. WEAVER, M.D.

Fluoroscopy in the Diagnosis of Pulmonary Tuberculosis. L. H. Garland. Am. Rev. Tuberc. **45:** 1–14, January 1942.

From his own experience, the author does not believe that fluoroscopy can approach roentgenography in the detection of pulmonary tuberculosis. A review of the published studies of others on the accuracy of fluoroscopy shows that the percentage of error as contrasted with roentgenography varies from 13 to 35 per cent even in the hands of experts. From the economic standpoint, the cost of fluoroscopy of private patients approaches that of roentgenography because of the time entailed. Even in mass surveys where 20 or 30 patients are examined in an hour, the cost of fluoroscopy is not negligible because of the necessity of assistants to supervise patients and take care of records. The author believes that the proper rôle of fluoroscopy in the examination of the chest is as an adjunct to radiographic examination; in mass surveys it is far superior to simple physical examination but not nearly so accurate as properly conducted roentgenographic studies.

LESTER W. PAUL, M.D.

Pulmonary Manifestations of Azotemia. R. A. Rendich, A. H. Levy, and A. M. Cove. Am. J. Roentgenol. **46:** 802–808, December 1941.

Six cases showing roentgenographic evidence of pulmonary edema associated with elevated blood urea and creatinine are reported. Theories as to the cause of the pulmonary edema are discussed, and the impression is gained that it is probably related to left ventricular failure. It occurs in only a small percentage of patients with nitrogenous retention. In the latent form it may be unrecognized without roentgenologic study.

The roentgen appearance considered characteristic of an "azotemic lung" is a symmetrical, diffusely increased and irregular shadow located in the central and basal lung fields, the density decreasing gradually toward the periphery of the lung. The costophrenic sulci are seldom obliterated. If the roentgenographic appearance remains constant the prognosis is poor.

H. H. WRIGHT, M.D.

Roentgenographic Features of Perforated Interlobar Abscess (Interlobar Empyema). B. Copleman and H. Neuhof. Am. J. Roentgenol. **46:** 798–801, December 1941.

Of 650 cases of empyema treated at Mt. Sinai Hospital, New York, in a ten-year period, 16 were examples

of localized interlobar empyema. All of these were found to be due to ruptured lung abscess. The roentgenological findings present in nine of the cases and considered diagnostic or at least suggestive of the condition were: (1) an interlobar collection of fluid, air, or both fluid and air, (2) a fluid level on or near a fissure, (3) an alteration of the shape of a fissure limiting an intrathoracic lesion, and (4) progression of disease along a fissure. In seven of the cases there were no distinctive roentgenological signs. In three of these the hemithorax was obscured by pleural effusion.

H. H. WRIGHT, M.D.

Attempt at the Clinical Evaluation of Roentgen Kymography. W. G. Scott. Am. J. Roentgenol. **46:** 778–783, December 1941.

An analysis is made of the author's experience with roentgen kymography for a one-year period, from July 1939 to July 1940, with regard to (1) the frequency with which roentgen kymograms were ordered, (2) their diagnostic purpose, and (3) the information which they contributed. Use of the procedure is reported in one or more cases of each of the following conditions: aortic regurgitation, subacute bacterial endocarditis, congenital heart disease, cor pulmonale, neurocirculatory asthenia, cardiac psychosis, mediastinal mass, constrictive pericarditis, pericardial effusion, toxic myocarditis, rheumatic heart disease, arteriosclerotic heart disease, hypertensive heart disease, coronary artery disease. It was employed, also, in a group of "check-ups" in which it was necessary to rule out the presence of heart disease.

It is concluded that roentgen kymography is not a routine procedure for the diagnosis of heart disease but should be restricted to a selected group of cardiac patients in whom the clinical picture is obscure or incomplete. The procedure is particularly helpful in establishing the diagnosis of pericarditis, pericardial effusion, and, to a lesser degree, of coronary artery disease and coronary infarction. The kymographic interpretation does not represent a complete study of the heart, but when made after careful analysis by one understanding its limitations, as well as its possibilities, it is of aid in evaluation of many cardiac diseases.

H. H. WRIGHT, M.D.

Roentgen Kymography in Constrictive Pericarditis. L. G. Rigler, O. H. Wangensteen, and H. L. Friedell. Am. J. Roentgenol. **46:** 765–777, December 1941.

Constrictive pericarditis does not always present a clearly defined clinical picture and, since in a majority of cases pericardiectomy is a curative procedure for this condition, any aid in early and accurate diagnosis is to be welcomed. Roentgen kymography, because it records the amplitude of cardiovascular pulsations, has proved to be a valuable procedure in diagnosis as well as in study of onset and progress of this disease, and in evaluating the results of surgery. It is a useful supplement to fluoroscopy in that it provides a permanent record for serial study and permits observation of details ordinarily not visible on the fluorescent screen.

Four cases are reported in which the diagnosis of constrictive pericarditis was made or confirmed by roentgen kymography. In three of these, postoperative kymograms were made, showing the change in cardiac pulsations following pericardiectomy. In one case the constriction was localized, but diagnosis was possible with the aid of the clinical findings, as there were no other observations consistent with myocardial infarction, which might have produced a similar appearance on the kymogram. A fifth case is presented in which there was calcification of the pericardium with normal cardiac pulsations. Still another case presented some of the characteristic clinical findings of constrictive pericarditis, but this condition was excluded by demonstration of fairly normal amplitude of cardiac pulsations. At autopsy this patient showed occlusion of the inferior vena cava by a tumor.

H. H. WRIGHT, M.D.

Radiological Consideration of Coarctation of the Aorta (Adult Type). C. L. Ash. Canad. M. A. J. **45:** 505–508, December 1941.

In the past thirteen years 7 cases of coarctation of the aorta have been recorded at the Toronto General Hospital. Of the 7 cases, 2 were recognized only at autopsy and 4 presented characteristic roentgenographic changes that enabled a positive diagnosis to be made. Only the adult or acquired type of coarctation is considered.

The etiology of coarctation of the aorta is not definitely known. The general consensus is that it is the result of an abnormal extension of tissue peculiar to the ductus arteriosus into the aortic wall. As a result of constriction an extensive collateral circulation is established between the left subclavian and innominate arteries, and internal mammary, intercostal, and dorsal scapular arteries; the internal mammary, in turn, connecting with the deep epigastric and the aorta. The condition occurs twice as frequently in males as in females. One author estimates that it is encountered in 1 of every 1,550 autopsies (Blackford, L.: Arch. Int. Med. **41:** 702, 1928).

Clinical symptoms, when they are present, are often those of hypertension and may include precordial pain, headache, dyspnea, vertigo, etc. Clinical manifestations on which a diagnosis may be made are: (1) evidence of collateral circulation, (2) feeble or absent pulsation in the abdominal aorta, femoral arteries, and arteries of lower extremities, (3) marked discrepancy in the blood pressure readings in upper and lower extremities, (4) atypical murmurs and thrills, and (5) hypertension. It is interesting to note that one author in checking patients in a hypertension clinic discovered 5 cases of coarctation of the aorta that had been diagnosed as essential hypertension (Lewis, T.: Heart **16:** 205, 1933).

Evidence on which a roentgen diagnosis can be made is of two types: first, findings consistent with a positive diagnosis; second, findings confirming or suggestive of a coarctation. Findings consistent with a positive diagnosis are erosion of the ribs and narrowing or complete absence of a portion of the aorta in the region of the isthmus. Erosion is most commonly seen in the 4th to 9th ribs and appears as a notching or indentation along the inferior aspect of the rib, particularly in the posterior portion, without other evidence of bone change. The narrowing or complete absence of a portion of the aorta is difficult to demonstrate. Suggestive or confirmatory signs of coarctation are absence of the aortic knob, left ventricular hypertrophy, increase in width of the shadow of the ascending aorta and great vessels of the neck.

Two cases observed in 1940 are described briefly. The first patient was a white female, nineteen years of age, who complained of precordial pain and exercise intolerance. Palpable, pulsating vessels and murmurs throughout the precordium and over the vessels of the back and neck were present. Blood pressure in the upper extremities was increased. Blood pressure in the lower extremities could not be obtained. Roentgen examination revealed characteristic erosion of the posterior portions of the 5th to 7th ribs on the right side and the 5th to 9th ribs on the left, widening of the ascending aorta, and enlargement of the left ventricle.

The second patient was a white male, twenty-three years old, who complained of convulsive seizures of two weeks' duration, frontal headaches, and epigastric distress. Clinical manifestations were cardiac enlargement with murmurs over the whole precordium and the posterior chest wall, visible pulsating vessels in the neck and suprasternal notch, and a blood pressure in the

upper extremities of 220/120 and in the lower extremities of 130/110. Roentgen examination revealed typical rib changes, absence of the aortic knob, left ventricular hypertrophy, and a break in the aortic shadow in the region of the isthmus. The break in the aortic shadow is well visualized in a reproduction of a film accompanying this report.

M. L. CONNELLY, M.D.

THE DIGESTIVE TRACT

Value of Co-operation Between the Radiologist and the Gastroscopist. S. W. Davidson and J. D. Rose. Brit. J. Radiol. **14:** 307–319, October 1941.

Gastroscopy is not the rival of roentgenology. They are complementary methods. Each has a field in which it has superiority. The radiographic examination gives more information in lesions on the lesser curvature of the antrum, lesions on the greater curvature, lesions in the distal pouch of an hour-glass stomach, and a better estimation of the extent of an antral carcinoma. Gastroscopy gives much more accurate information regarding the healing of a gastric ulcer, the early diagnosis of a malignant neoplasm, and the identification of polyposis, and gastritis.

In a general way in any patient with indications for a barium meal examination gastroscopy is also indicated. Usually the roentgen examination should precede the gastroscopy.

In 600 gastroscopies, 256 of which were preceded by roentgen examination, the diagnosis of carcinoma was confirmed 39 times, and refuted 37 times. Thirty-seven patients were thus probably saved a laparotomy. In 7 cases carcinoma was discovered by the gastroscope when it had not been discovered by fluoroscopy. Thirty-nine cases of ulcer diagnosed by x-ray examination were confirmed. In 7 instances the diagnosis of ulcer was refuted. In 4 cases ulcers were found on gastroscopy which were not identified by roentgen examination. Two cases of polyps were confirmed and two cases not seen by x-ray were discovered. In one case a roentgen diagnosis of extragastric carcinoma was changed to gastric carcinoma after gastroscopy. In only one case did gastroscopy fail to show a carcinoma found subsequently at operation. This case could have been demonstrated roentgenologically, but the examination was not done.

A plate in color and numerous roentgenograms illustrate this paper. SYDNEY J. HAWLEY, M.D.

Ulcerated Leiomyoma of the Stomach: Report of a Case. E. G. Martel. Rev. méd. cubana **53:** 33–37, January 1942.

Leiomyoma of the stomach is a rare tumor. It occurs most often in the antral portion and may grow from or into the lumen of the stomach. When its growth is from the lumen it will remain silent and be discovered accidentally during a routine examination. When its growth is into the lumen the tumor quite often ulcerates, causing profuse hemorrhage and melena with little or no disturbance of gastric function. The ulcers may become infected and become a focal port of entry for distal inflammatory processes or they may undergo sarcomatous change.

The case reported is one of a 42-year-old white female who for years had suffered profused melena, with resultant secondary anemia. Roentgenologic gastric exploration six years earlier had revealed a filling defect in the greater curvature close to the fundus, about the size of a silver dollar. Three years later the mass showed considerable increase in size and evidence of ulceration. One year after this some regression of the tumor was noticed. A diagnosis was now made of leiomyoma, ulcerated and accompanied by inflammation. Following radiotherapy through several ports of entry (5,000 r) bleeding stopped and the filling defect decreased in size. Gastroscopy was advised and desired for further confirmation but was refused.

A. MAYORAL, M.D.

Congenital Duodenal Obstruction. A. D. Vail and E. J. Schwartz. J. Missouri M. A. **39:** 12–18, January 1942.

The literature dealing with congenital duodenal obstruction is reviewed by the authors and a case is reported in detail. The rarity of this anomaly is conceded, although it is thought that this may be in part due to failure of diagnosis and a tendency to temporize in questionable cases until a fatal termination results.

Congenital duodenal obstruction, regardless of type, is almost universally accompanied by vomiting. When obstruction is complete, the vomiting begins soon after birth, is of projectile type, and usually recurs with each feeding. The presence of bile in the vomitus is an important sign but depends somewhat on the location of the obstruction and its relation to the ampulla. Obstructions due to stenosis more commonly produce intermittent symptoms and these frequently are delayed in their appearance as compared with those of the atretic types.

It is important in the diagnosis of this lesion that the possibility of its existence be kept in mind. Persistent bile-stained vomitus in any infant, in the absence of cerebral injury or infection, is highly suggestive of a congenital abnormality of the intestinal tract. Symptoms occur in the first two days in 65 per cent and within the first two weeks in 85 per cent of the cases. Roentgen examination is imperative. If a complete obstruction is suspected, a barium enema should be given first. In children under one week of age a flat film of the abdomen is recommended. If this reveals, by the presence of gas in various segments of the intestinal tract, that complete obstruction does not exist, it is considered safe to administer barium by mouth. A positive clinical syndrome plus roentgen findings of complete block with dilatation of the stomach and duodenum is suggestive of atresia. If the obstruction is incomplete, one must suspect stenosis of intrinsic origin, volvulus, or the presence of constricting bands.

The treatment is surgical. While posterior duodenojejunostomy seems to be the most satisfactory method, in some cases it cannot be done because of technical difficulties, and posterior gastro-enterostomy must be utilized. A bibliography of 63 references is appended.

LESTER W. PAUL, M.D.

Congenital Duodenal Obstruction. R. A. K. Harper. Brit. J. Radiol. **14:** 360–363, November 1941.

Congenital duodenal obstruction occurs in one case in 18,000. It may be due to valve formation, stenosis, or complete absence or suppression of a segment of the bowel, and is often found in close relation to the ampulla of Vater. It may also be the result of abnormal fixation of the duodenum, persistence of the hepatoduodeno-colic ligament, annular pancreas, or vascular anomalies.

The diagnosis is usually made in infancy. The symptoms are those of high intestinal obstruction. Vomiting usually occurs earlier than in pyloric stenosis.

X-ray examination reveals a distended and gas-filled stomach and proximal duodenum. The administration of barium will usually locate the point of obstruction definitely.

A case report of one patient who did not come for examination until the age of twenty is included. The obstruction in this case was not complete, and was due to an annular stenosis at the duodeno-jejunal junction. The patient showed, also, non-rotation of the cecum and cleft palate. SYDNEY J. HAWLEY, M.D.

Roentgenologic Studies of Inflammatory Tumors of the Cecum. M. de Abreu Companario. An. paulist. de med. e cir. **42:** 119–133, August 1941.

The author reports his observations, confirmed by operation, on four cases correctly diagnosed roentgenologically as inflammatory tumors of the cecum. He emphasizes the importance of the clinical examination and the absolute necessity of correlating this with the roentgen findings.

During fluoroscopic examination the shape and size of the organ, its location, motility, consistency, and precise relation to tumors or tumefactions palpated during the clinical examination should be carefully observed. When the roentgenologist can ascertain the existence of the tumefaction and can convince himself that it is part of the cecal wall the diagnosis is relatively simple. The differential diagnosis, however, is difficult at times, when the inflammatory mass is diffused into the surrounding tissue.

Sometimes the roentgenogram furnishes all the necessary data for a correct diagnosis. Quite often, however, careful clinical correlation is necessary.

A. MAYORAL, M.D.

Roentgenological Diagnosis of Primary Carcinoma of the Liver. R. Schatzki. Am. J. Roentgenol. **46:** 476–483, October 1941.

Review of 4,323 autopsies at Massachusetts General Hospital showed 15 cases (0.34 per cent) of primary cancer of the liver. The incidence of carcinoma of the pancreas, usually considered to be far more common, was only about three times as great in this series.

Primary liver carcinomas have been classified grossly as of three types: nodular, massive, and diffuse. Histopathologically the tumors may be (1) hepatomas, arising from liver cells proper, or (2) cholangiomas, or primary adenocarcinomas, originating from the intrahepatic bile ducts. Metastases are common in both types, the liver, periportal lymph nodes, and lungs being most commonly involved. Primary cancer of the liver in adults is frequently associated with cirrhosis of the liver, as is evidenced by 10 of the 11 hepatomas and 3 of the 4 cholangiomas in this series of 15 cancers.

Reports in the literature of roentgen findings in primary cancer of the liver are quite limited and consist largely of descriptions of deformities produced by general or localized enlargement of the liver, elevation of the diaphragm, or displacement of gastro-intestinal organs. The use of pneumoperitoneum and the intravenous injection of thorotrast have been suggested as diagnostic aids.

The author reports a case in which a diagnosis was made roentgenologically of primary carcinoma of the left lobe of the liver, based on the presence of esophageal varices (evidence of cirrhosis of the liver), a soft tissue mass arising from the region of the left lobe of the liver with displacement of stomach and duodenum but without enlargement of the right lobe of the liver, and on evidence of metastatic neoplasm in the lungs. The diagnosis was confirmed at autopsy. Three additional cases are reviewed, all of which showed a localized elevation of the diaphragm; at operation or autopsy, primary cancer of the liver, with cirrhosis, was found.

The roentgen signs most helpful in the diagnosis of primary liver cancer are esophageal varices (indicative of cirrhosis of the liver, and present in approximately 50 per cent of cases of cirrhosis) and demonstration of a coincident mass in the region of the liver, which may be seen on good roentgenograms of the abdomen or may manifest itself by displacement of stomach, duodenum, colon, or small intestine, or by a localized bulge of the diaphragm. Evidence of metastatic neoplasm, particularly in the lungs, adds to the probability of the diagnosis. While this syndrome is highly suggestive of primary carcinoma of the liver, it is not pathognomonic. Metastatic tumors, echinococcus cysts, and possibly gumma may also cause localized bulges of the diaphragm.

The diagnosis of primary carcinoma of the liver may at times justify an attempt at surgical removal.

H. H. WRIGHT, M.D.

May the Disease Complex That Includes Mega-esophagus (Cardiospasm), Megacolon and Mega-ureter Be Caused by Chronic Vitamin B_1 Deficiency? E. Etzel. Am. J. M. Sc. **203:** 87–100, January 1942.

There is strong evidence that mega-esophagus, megacolon, pylorospasm, mega-ureter, alterations in gastric chemistry and in the electrocardiogram, with associated polyneuritis and a low metabolic rate, are varied manifestations of a degenerative disease caused by a chronic deficiency of vitamin B_1. A study of the diet of the 170 Brazilian patients upon whom the present report is based revealed considerable evidence in favor of this concept.

Clinical evidence has been accumulated in the literature tending to show that mega-esophagus and megacolon are related manifestations, possibly of common etiology, and this concept may be expanded to include other associated morbid findings, such as pylorospasm, or more correctly, achalasia of the pylorus, and mega-ureter. The digestive and urinary tracts are similar anatomically and functionally, since both possess smooth muscle, several involuntary sphincters (such as the cardiac, pyloric, pelvi-rectal, internal anal, pyelo-urethral, urethro-vesical, and internal vesical), and are innervated by a comparable intramural autonomic nervous system. It has been suggested that the primary factor in the pathogenesis of mega-esophagus, megacolon, and mega-ureter is the absence of sphincteric relaxation, which normally occurs with the arrival of a peristaltic wave. This absence of relaxation, sufficient to prevent passage through the sphincter, establishes a functional obstruction resulting in stasis above it. There follow increased peristalsis and hypertrophy of the musculature, but not of the sphincter. A state of decompensation is reached when the hypertrophied musculature is no longer capable of overcoming the sphincteric inertia; dilatation and atony develop, and symptoms appear.

The intramural autonomic nervous system in the digestive tract consists of Meissner's plexus in the submucosa and Auerbach's plexus between the circular and longitudinal muscle coats. The latter plexus consists of nerves and ganglion cells of two types. The multipolar cells (type 1) occur throughout the tract. The unipolar cells (type 2) are first seen at the pyloric end of the stomach, and increase in number as the ileum is approached. From the cecum downward, they fall off, until none are found in the rectum. The esophagus and the rectum thus have the same type (multipolar) of cells. The greatest numbers of cells are found just above the sphincters. Cells of the same types make up the plexuses in the urinary tract.

Advanced degenerative changes were noted in these cells in cases of mega-esophagus, megacolon, and mega-ureter. The hearts of such patients are also impaired, as shown by electrocardiographic changes and the presence of similar degenerative changes in the cardiac plexuses. The patellar and Achilles reflexes may be diminished or absent. In severe cases, the disturbances in the reflexes may be generalized but are rarely the source of symptoms. Other disturbances included a decrease or absence of free hydrochloric acid and a low basal metabolic rate in a high percentage of the patients.

A study was made of the dietary habits and geographic distribution of these patients in an attempt to find a clue to the etiologic agent. It was found that the disease occurred predominantly in young males of the laboring classes coming from regions where, for economic reasons, the diets are unvaried, composed largely of carbohydrates, and deficient in vitamin B_1. Those

patients found in prospercus regions had moved there from areas where the disease was endemic.

Degeneration of the plexus of Auerbach is irreparable, although there may be some improvement with vitamin B_1 therapy. The development of symptoms in the presence of an adequate diet indicates that the early stages of the disease were present prior to migration from a poorer district. These early stages lead to symptoms, despite the suggestion that further degeneration has been prevented by the adequate diet.

BENJAMIN COPLEMAN, M.D.

THE SKELETAL SYSTEM

Tuberculosis of the Hip: Review of 76 Patients with Proved Tuberculous Arthritis of 77 Hips Treated by Arthrodesis. C. E. Badgley and G. Hammond. J. Bone & Joint Surg. **24:** 135–147, January 1942.

In all 76 cases of tuberculosis of the hip joint here recorded, the diagnosis was proved by pathologic or bacteriologic means.

The onset of the disease is insidious and slowly progressive. In 37 per cent of this series the probable source of infection was some member of the family. Some type of flexion deformity was present in 86 per cent (flexion in 38 per cent; flexion adduction in 30 per cent; flexion abduction in 18 per cent). Of 50 patients who had tuberculin tests, 47 gave positive reactions and 3 negative reactions.

Roentgenograms were available in 67 cases. In 6 per cent of these the roentgenographic changes consisted in loss of joint space and osteoporosis; 33 per cent showed mild destructive change, 27 per cent moderate destruction, and 33 per cent advanced destruction. One patient showed no change on first examination. In 50 per cent of the cases destruction was primarily in the acetabulum; in 32 per cent in the femoral head; in 14 per cent in the femoral neck; in 4 per cent in the greater trochanter.

The authors' plan of treatment calls for a preoperative period of conservative treatment averaging thirteen months, during which the general condition of the patient is built up, other foci of disease are treated, and the hip is put at rest.

The type of arthrodesis varied with the case and attending surgeon. Postoperatively the patient spent about ten months in a plaster spica with additional immobilization for about nine months. Ankylosis usually resulted in about fifteen months. A second arthrodesis was required in 16 per cent of the cases.

The results in this series are classified on both an objective and subjective basis. If both are taken into consideration, the following figures are obtained: mortality 18 per cent, indicating the seriousness of the condition; good results, 52 per cent; fair, 22 per cent; poor 8 per cent.

The following conclusions are drawn: After the age of eight years the arthrodesis has a better chance of success than in younger patients, but after thirty years the results are poorer. Other tuberculous foci have a bad effect on prognosis. If during the preoperative period improvement occurs, whether continued or followed by destruction, the prognosis is good. Progression of destruction demonstrable roentgenologically is an unfavorable indication if the patient has had less than 6 months of conservative care. The type of arthrodesis seemed not to influence the result. The presence of sinus tracts and secondary pyogenic infections, especially in adults, increased the hazard.

JOHN MCANENY, M.D.

Polyostotic Fibrous Dysplasia. K. Kornblum. Am. J. Roentgenol. **46:** 145–159, August 1941.

The most striking feature of polyostotic fibrous dysplasia are the bone changes as shown by roentgen examination, consisting of irregular areas of decreased density having a ground-glass appearance exactly as in osteitis fibrosa cystica. These areas are often interspersed with bony trabeculae. The lesions are multiple, scattered, but not generalized, with a distinct tendency to be unilateral. The most common sites are the lower limbs, but any bone may be involved.

With increase in size of the lesions the cortex thins and there may be a slight expansion of the bone. From dysfunction deformities may develop, particularly coxa vara and bowing of the femur and tibia.

In young patients during the active stage of the disease, no reactive bone changes occur, but in adults attempts at regeneration are noted. With increasing age of the patient the lesions show a tendency to retardation, though they never disappear.

The name of this condition, coined by Lichtenstein and Jaffe in 1938 (see Arch. Surg. **36:** 874, 1938), is descriptive of the multiplicity of the lesions (polyostotic) and the underlying abnormality of development of the bone during its fibrous state (fibrous dysplasia).

The usual clinical manifestations are pain, limp, and deformity of one lower extremity. Pathologic fracture, especially of the femur, is common. Onset of symptoms is insidious. The disease is never fatal and evidently never cured.

The serum calcium and phosphorus are not significantly changed. Serum phosphatase is only moderately increased. These findings will usually serve for differentiation from hyperthyroidism, but occasionally the blood studies are not definitely diagnostic.

On pathologic examination no cysts are found as in osteitis fibrosa cystica, the cystic appearance in the roentgenogram being due to the presence of trabeculae of primitive, poorly calcified new bone traversing the grayish-white fibrous tissue which fills the marrow cavity.

S. M. ATKINS, M.D.

Changes in Bones, Joints and Soft Tissues Associated with Disease or Injury of the Central Nervous System. J. F. Brailsford. Brit. J. Radiol. **14:** 320–328, October 1941.

The arthropathies are the most common and important changes in the skeleton associated with affections of the central nervous system. Myositis ossificans and ectopic bone formation may also be seen.

The arthropathies (Charcot joints) are usually found between the ages of thirty-five and forty, but are occasionally met with at other ages. The changes appear to be initiated by some trigger mechanism, usually a trauma, which may be less than would produce a similar effect in normal bones and joints. The changes progress slowly, over months and even years. Four stages may be recognized: hydrarthrosis, disintegration, hypertrophy, and atrophy.

Effusion into a joint after relatively mild trauma, particularly if associated with little or no pain, should raise the suspicion of an early arthropathy. Swelling, widening of the joint space, thickening of the periarticular structures, and often increased sharpness of the bone outlines are characteristic of this stage. The last of these is due to an increased density in the bony structure.

The stage of disintegration is characterized by lack of stability of the joint, swelling, and brawny edema. The bony surfaces show an irregular wearing down, usually with persistence of the increased density of the bones and sharp outlines, though later these may appear somewhat irregular because of flocculent deposits of calcium.

In the hypertrophic stage the affected joint appears swollen. The edema and discoloration have disappeared, and there are undue motion and instability. Roentgenograms indicate that the calcium deposits, both intra-articular and extra-articular, are undergoing organization. There may be attempts by hypertrophic bone to extend the articular surfaces.

The stage of atrophy reveals reduced swelling and atrophy of the muscles surrounding the joint. Roentgenograms show diminution of the extent and density of the expanded socket and still further absorption and diminished density of the extremity of the long bone. A cancellous structure of the bone re-appears and the articulating surfaces may look irregular and frayed.

This sequence occurs only once in an affected joint.

In a small percentage of cases, following contusion a sequence of events will take place in the muscle, usually adjacent to bone, resembling the arthropathies. In the early stages there are swelling and brawny edema. Flocculent deposits of calcium appear, which gradually increase, usually showing density greater than normal bone and subsequently undergoing organization. The adjacent cortex shows slight loss of calcium. The appearance may closely resemble sarcoma. Since biopsy, operative interference, and irradiation therapy are apt to delay healing, a correct diagnosis is important.

The changes described both in the neuropathic joint and in myositis ossificans would appear to be related to a nerve injury. SYDNEY J. HAWLEY, M.D.

Anatomical Explanation of Traumatic Low-Back Pain. E. J. Haboush. J. Bone & Joint Surg. **24:** 123–134, January 1942.

Every treatise on low-back pain is worth thorough reading and this one is especially so, since it attempts to demonstrate the anatomical mechanics and their results. The author assumes that the origin of many low-back pains is trauma from flexion of the lumbar spine, and sustains this assumption by reasoning that in the act of lifting there is a tug-of-war between the spinal muscles, on one hand, and the more powerful extensor muscles of the hips and hamstrings on the other [the rectus abdominis is not mentioned]. The brunt of all this force is centered in the lumbar spine and lumbosacral junction.

In the first, second, and third vertebrae of the lumbar spine the leverage and the distance between the tips of the transverse processes are progressively increased downward and the processes are horizontal. In the fourth and fifth vertebrae the transverse processes are often smaller, incline upward, and join the vertebrae more anteriorly, resulting in unequal distribution of stress and loss of lev.rage. The lumbosacral junction is re-enforced by the iliolumbar ligaments and by the capsules of the lumbosacral joints, but in the fourth interspace the thin intertransverse ligaments receive undue and unequal stresses, and it is this interspace, therefore, that is the weak spot in the lumbar spine.

To show the effect of flexion, anatomical specimens of the lumbar spine attached to the pelvis with the posterior ligaments and fascia in place were subjected to gradual forced flexion. With the application of force, motion begins in the lumbosacral junction but is quickly checked by the iliolumbar ligaments; it then begins in the fourth interspace, the apex of the lumbar curve and the seat of greatest motion. Less motion occurs in the third and still less in the second interspace and in these only after the limit of motion has been reached in the fourth interspace.

When the limit of flexion of the lumbar spine is reached, the supraspinal ligament and lumbar fascia act as a check, causing rotation and lateral deviation of the spine with transfer of tension to the iliolumbar ligament, quadratus lumborum fascia, and intertransverse ligaments on the convex side.

If forced flexion is continued, the intertransverse ligament and quadratus lumborum fascia between the fourth and fifth vertebrae on the convex side may rupture. With these structures torn, tension falls upon the articular capsule and the annulus fibrosus, and with continued force the tear extends through the lateral fibers of the anterior and posterior longitudinal ligaments, the articular capsule, ligamentum flavum, and the interspinal ligament. With increased flexion the supraspinal ligament tears and rupture extends to the opposite of the spine with tearing of the same structures in reverse order.

This demonstration offers some reasons for low-back pain, even to the extent of herniation of the intervertebral disc and injury to the ligamentum flavum. None of the specimens studied showed any injury to the sacroiliac joints or ligaments. A clinical study is to be presented at a later date. Excellent illustrations accompany the article. JOHN MCANENY, M.D.

Sciatic Pain: Its Significance in the Diagnosis of Cauda Equina Tumors. Report of Four Cases. A. Kaplan, M. B. Bender, and M. Sapirstein. J. Bone & Joint Surg. **24:** 193–199, January 1942.

Sciatia of unknown origin is most commonly attributed to herniation of a nucleus pulposus or hypertrophy of the ligamentum flavum. With attention focused on these causes the diagnosis of a cauda equina tumor is likely to be overlooked unless kept in mind. Sciatic pain may, however, continue for varying periods from this cause, without significant objective findings. In such cases of persistent pain the patient should have the benefit of thorough clinical investigation including roentgenograms of the spine, manometric tests, analysis of spinal fluid, air myelography, and, if necessary, lipiodol studies. Too frequently these cases go unrecognized until unequivocal neurological signs are present and irreparable damage has been done to the nervous tissue. These late signs include paresis, secondary demarcation, and impaired sphincter control.

Reports of four proved cases are included in the paper. In none of these was there any motor, sensory, reflex, or sphincter disturbance when the diagnosis was made. In each instance the diagnosis was established by combined study of the spinal fluid and lipiodol studies. Three cases showed a typical "cap deformity" after interspinal injection of the contrast medium.

JOHN MCANENY, M.D.

Multiple Striae Parallel to Epiphyses and Ring Shadows Around Bone Growth Centers. C. A. Stammel. Am. J. Roentgenol. **46:** 497–505, October 1941.

Two cases are reported in which roentgenologic survey of the skeleton showed similar and unusually extensive parallel dense lines extending into the shafts of the long bones, concentric ring shadows in the small bones, and many alternating bands of increased and decreased density in the alae of the pelvis. The distal epiphyses of the radii were not fused in either case. Both patients were soldiers from farms in Georgia, the first aged twenty and the second nineteen. There was nothing in the past history of either to offer an explanation of the unusual skeletal findings, and no evidence of syphilis or of previous rickets. In the first case the teeth showed extensive abnormalities: congenital absence of two teeth, residual deciduous and unerupted teeth, marked attrition of all anterior teeth, hyperplasia of the enamel of several teeth, and white spots in all of the molars. These findings are considered evidence of some local or general systemic condition which interrupted the nutrition of odontoblastic, ameloblastic, and cementoblastic tissues. The second case showed no dental abnormality.

The exact cause of the skeletal changes seen in these two cases is undetermined, although it is reasonable to suppose that something occurred, during the period when the bones were undergoing growth most rapidly, that temporarily caused a delay or cessation of growth. The similarity in the changes which may be produced by scurvy, congenital syphilis, rickets, Albers-Schönberg disease and phosphorus, lead, strontium, or bismuth ingestion is noted, with references to the literature. It is felt that the first case may be one of mild

or atypical Albers-Schönberg disease, although it did not show generalized endosteal osteosclerotic changes in the entire skeleton, an abnormal tendency to fracture, or definite changes in the morphology of the blood. Dr. R. S. Bromer, who saw the films in these cases, believed that periodic decreases in thyroid function might be the cause of the unusual skeletal findings and pointed to the failure of fusion of the distal epiphyses of the radii as additional evidence of hypothyroidism. The questionable accuracy of ages given by soldiers on enlistment in the army makes this latter finding of uncertain value. Repeated, mild unrecognized attacks of scurvy are also considered as a possible explanation, as is ingestion of lead during childhood. The appearance of the teeth was not considered suggestive of fluorine intoxication. H. H. WRIGHT, M.D.

Appearance and Nature of Cyst-like Areas in the Distal Femoral Metaphyses of Children. L. W. Sontag and S. I. Pyle. Am. J. Roentgenol. **46:** 185–188, August 1941.

This article is based on serial roentgen study of 200 children examined at birth and subsequently at three- and six-month intervals until the age of eighteen years.

Translucent cyst-like areas, usually of 1 to 3 sq. cm., are frequently demonstrable in the medial aspect of the distal metaphysis of the femur in children between the ages of two and nine years. These circumscribed areas are the result of local removal of bone salts. They occurred at one time or another in 53 per cent of the boys and 22 per cent of the girls in the authors' series. Their average duration was twenty-nine months. They are asymptomatic and disappear spontaneously. They are frequently bilateral. The condition is believed to be due to the inclusion of small groups of cartilage cells in the invading metaphysis, which stimulate the activity of osteoclasts. The resultant bone destruction permits growth of the cartilage cells. These pseudocysts may not be greatly different from solitary bone cysts except in the degree to which they progress. They must be differentiated from such infections as Brodie's abscess, syphilitic abscess, and pyogenic abscess. S. M. ATKINS, M.D.

Roentgen Study of the Bone Lesions Found in Engel-Recklinghausen Disease and Report of Three Cases. S. Hermeto, Jr. An. paulist. de med. e cir. **42:** 3–28, July 1941.

This is a rather lengthy essay in which the author describes in detail all the classical bone findings of osteitis fibrosa cystica. Practically all changes that have been observed are found in one or the other of the three cases presented. A. MAYORAL, M.D.

Cases of Nonspecific Bone Infection with Unusual or Obscure Features. R. W. Lewis. Am. J. Roentgenol. **46:** 659–666, November 1941.

A number of cases are presented, indicating the difficulties that may be encountered in roentgen diagnosis of bone infections. These include 2 cases of staphylococcic abscess mistaken for tuberculosis; a giant-cell variant of osteitis fibrosa cystica in which the roentgen picture was exactly similar to a case believed (but not proved) to have been a staphylococcus infection; one case of staphylococcic and one of tuberculous bone abscess which were indistinguishable roentgenographically; 2 cases of presumably non-tuberculous abscess and one of tuberculous abscess presenting many features in common as studied roentgenographically.

March Fracture of the Femur: Report of a Case. L. T. Peterson. J. Bone & Joint Surg. **24:** 185–188, 1942.

A 17-year-old male suffered sudden severe pain in his left thigh during calisthenic drill, after many months of leisure. A roentgenogram showed a small crack in the femoral cortex, which was dismissed as unimportant. Three weeks later a film showed a "bony tumor" of the lower femur, considered to be an osteogenic sarcoma. Re-examination of the film suggested an incomplete fracture of the femur and later studies showed progressive callus formation.

The importance of this case lies in the fact that the early impression was that of osteogenic sarcoma and only after continued study was the true nature of infraction recognized. [The term march fracture is commonly applied to fractures of the metatarsal. See Krause: Radiology **38:** 473, 1942.—ED.]

JOHN MCANENY, M.D.

Congenital Absence of Odontoid Process of the Axis with Atlanto-Axial Dislocation. H. G. Weiler. J. Bone & Joint Surg. **24:** 161–165, January 1942.

This is a case report of a 14-year-old girl who fell and for a week complained of pain and stiffness of the neck. Her head was turned to the left, with the chin tilted upward in the opposite direction. Roentgenograms showed absence of the odontoid process with lateral displacement of the atlas to the left and posteriorly. Traction for one week produced no result but reduction was obtained by manipulation under anesthesia, and a plaster cast was applied.

Later, operative fusion of the atlas and axis was done with autogenous rib grafts sutured to the posterior arch of the atlas and spinous process of the axis. Satisfactory bony union occurred and good function with stability resulted. JOHN MCANENY, M.D.

THE GENITO-URINARY TRACT

New Table for Cystoscopy, Fluoroscopy, and Roentgenography. D. M. Davis. J. Urol. **45:** 894–902, June 1941.

The author succinctly describes and illustrates, by six photographs, a table which permits cystoscopy, fluoroscopy, and radiography at will, with minimal inconvenience to the patient. The advantages of adding fluoroscopy to the common combination of cystoscopy and radiography are apparent, and were pointed out by the author in 1929 (J. Urol. **22:** 339, 1929). Accurate determination of the position of the ureteral catheter and of calculus-removing instruments, careful control of the amount of opaque media required to fill the pelvis completely, the possibility of palpation of the kidney and ureteral regions and of observing the emptying time of the kidney pelvis, are some of the advantages mentioned.

The central and exclusive feature of this table is a sliding carrier by which the patient can be comfortably drawn from the cystoscopic position at the end of the table to a point where a film can be taken, or the fluoroscope used, with equal facility and perfect centering. From a roentgenologic point of view, the table is built upon the foundation of a more or less standardized x-ray table, including motor-driven tilting adjustment from the upright to the 30° Trendelenburg position. The carrier moves easily on ball bearings. On it are knee rests and also clamps to steady the cystoscope at any desired position. The fluoroscopic unit and radiographic tube are shock-proof. A rotating anode tube may be used. BENJAMIN H. ORNDOFF, M.D.

Roentgen Demonstration of the Urethro-Vesiculo-Deferential Reflux. C. de Moraes Barros and A. A. da Motta Pacheco. An. paulist. de med. e cir. **42:** 47–56, July 1941.

The writers describe the historical development of urethrography, including the different opaque media and their gradual and progressive modifications to date.

At present the most frequently used medium is a 12 per cent solution of sodium iodide, not only because of its low cost but because of the excellent roentgenograms it produces, and because it is well tolerated. Aqueous solutions are preferred to oily solutions because the latter do not mix well with the urine and may produce false images difficult of interpretation. Massage of the prostate previous to urethrography is advised.

The authors' technic calls for three exposures: one antero-posterior, one right oblique, and the other left oblique. The exposures are made during the act of micturition or while the opaque media is being injected into the bladder.

The authors consider the occurrence of urethro-vesiculo-deferential reflux to be very rare. They have accumulated 386 urethrograms but in only two cases was the condition present. Statistics from other sources show it to be equally rare.

The authors state that they do not present clinical observations as their data are insufficient. There is some confusion as to the actual cause of the reflux. Tuberculosis of the male genital organs, orchiepididymitis, and ulcerative lesions of the verumontanum have been mentioned as etiologic factors, but without convincing evidence. The essayists suspect chronic lesions of the posterior urethra to be a cause in some instances.

A. MAYORAL, M.D.

MISCELLANEOUS

A New Technique for the Arteriographic Examination of the Abdominal Aorta and Its Branches. P. L. Fariñas. Am. J. Roentgenol. **46:** 641–644, November 1941.

To avoid blind puncturing in the arteriographic study of the abdominal aorta, the femoral artery at Scarpa's triangle is exposed by blunt dissection under local anesthesia. It is punctured with a trocar through which a catheter is passed and introduced to the desired level in the aorta. The patient is then placed in position according to the organ to be studied.

After preliminary details are completed, 20 or 30 c.c. of 70 per cent diodrast are injected within two or three seconds and a fast Bucky film is made. No accidents have occurred and patients are able to walk to their beds after the injection.

The arteriographic study of the abdominal organs gives much information concerning the anatomical and functional disorders through the modifications of the circulation. This method is used only where other methods fail to locate the site of a probable lesion.

Roentgenologic Examination of the Soft Tissues: I. Technical Considerations. II. Study of the Axillary Region. G. J. Melot. Am. J. Roentgenol. **46:** 189–195, August 1941.

Roentgenography of soft tissues involves many technical difficulties. This is due to the fact that the absorption coefficients of the soft tissues are very weak and very closely related. Moreover, for the same region these coefficients vary with each individual, as a result of the disposition of muscular and fatty tissues, as well as their degree of hydration. These variations cannot be foreseen. In order to avoid this difficulty, the following technic has been established: A roentgenogram is taken under a graduated aluminum filter. From this test film, the filter thickness giving the best contrast for each patient is chosen. Tension and milliamperage are practically the same as for roentgenograms of bone. The variable factor is, therefore, not kilovoltage but filtration. Special non-screen film, giving more contrast than the ordinary film, is used, with the Potter-Bucky diaphragm.

In order to apply the technic described to the axillary region, the normal aspect of the axilla was carefully studied from series of roentgenograms of autopsied sections, in which metallic guides had been set to show the normal structures. This method was then used for roentgenograms of the disease-free axilla and similar detailed investigations were carried out in patients with axillary metastases, chiefly those from cancer of the breast. The arm is held at a 90-degree angle.

S. M. ATKINS, M.D.

RADIOTHERAPY

MALIGNANT NEOPLASMS

Mucous and Salivary Gland Tumors: Report on a Series of 57 Cases with Special Reference to Radium Treatment. M. Lederman. Brit. J. Radiol. **14:** 329–335, 368–375, October and November 1941.

Mucous and salivary gland tumors include both tumors of large salivary glands and similar tumors occurring within or in the neighborhood of mucous membranes with serous, sero-mucous, or mucous glands. The commonest is the so-called mixed tumor.

In the Royal Cancer Hospital, London, 57 mucous and salivary gland tumors were treated between 1929 and 1940. Eighteen of these are classified as benign and 39 as malignant. In the malignant group were found mixed tumors, basal-cell carcinomas, adenocarcinomas, and squamous-cell carcinomas. It is commonly believed that the benign tumors may undergo malignant change. It is probable, however, that in such cases the tumor was malignant from the beginning, but due to the mixed nature of the neoplasm, and its slow growth, its true character was not realized. Biopsy does not seem advisable unless the tumor is ulcerating, as trauma to the capsule may cause dissemination. Furthermore, the mixed nature of many of these tumors may make the biopsy valueless, as the specimens may not be sufficiently inclusive.

Of this series of 57 tumors, 44 were in the parotid, 6 in a submaxillary gland, 3 in the antrum, 2 in the hard palate, and 1 each in the soft palate and anterior nares. Benign tumors are usually said to occur most frequently in the fourth decade, and malignant in the sixth. The average age of the author's patients with benign tumors was fifty years, of those with malignant tumors involving the parotid and submaxillary glands 60.6 years, and of those with malignant growths of the palate, antrum, and nares, 55.8 years. The average duration of symptoms for the three groups was, respectively, 8 years 8 months, 7 years 2 months, 1 year 8 months. As is generally held, the benign tumors were of more frequent occurrence in women, the malignant in men. Eleven of the benign mixed tumors occurred on the left side and 6 on the right, confirming the statements found in the literature as to the preponderance of left-sided involvement. Twenty-two of the malignant tumors occurred on the right and ten on the left. One patient had a bilateral tumor, and in one a tumor developed on the opposite side eighteen years after excision of a parotid tumor.

Sixty-four per cent of the main salivary gland tumors were malignant. The first sign in these cases is usually a lump, painless and not well defined. Unless it is of long standing, the tumor is not usually adherent to the skin or underlying structures. Twenty-three per cent of the malignant cases showed paralysis of the facial nerve. Other writers have found a higher incidence of this complication. All of the 7 tumors occurring outside of the salivary glands were malignant.

The benign tumors present themselves as well defined movable tumors, often lobulated. They are rarely painful or tender, growth is slow, and paralysis of the facial nerve is extremely rare, though it has been recorded. The benign tumors are especially inclined to recurrence; this may be due to incomplete removal or multiple foci of origin, or a second tumor may arise, *de novo*, after primary excision. Of 14 previously untreated benign tumors in this series, 9 showed no recurrence. Most of these were treated with surgery and postoperative irradiation.

Metastasis from the malignant tumors is generally believed to be late and uncommon. Thirty-one per cent of the tumors of the main salivary glands in this series showed clinical lymph node involvement at some time. In 3 of 15 patients who died it was possible to demonstrate distant metastasis, in 2 in the skin and in 1 in the lungs. Only one of the extra-salivary gland tumors showed invasion of the lymph nodes; in none was there evidence of distant metastasis.

Treatment for mucous and salivary gland tumors should be individualized and started as early in the disease as possible. Ahlbohm laid down certain principles as to indications for irradiation, surgery, and a combination of the two (Acta radiol. Suppl. 21, 1935), which are summarized here. Postoperative irradiation is indicated in many cases. Inoperable tumors should be vigorously treated by suitable combinations of teleradium and radium implants.

A fractional method of treatment with radium at a distance is used at the Royal Cancer Hospital, giving a daily surface dose of from 280 to 340 r per field, in four to six weeks. The number of fields and their size depend upon the extent and location of the tumor, running from two to six. The number, size, and arrangement of fields may have to be readjusted during the course of treatment as the tumor changes in size. The regional lymph nodes should also be irradiated.

Implantation of needles is indicated in some cases. These may be put into the wound immediately after surgery. They may be used after external irradiation for the treatment of residual tumors, and for localized and accessible recurrences, and occasionally for palliation when further external irradiation seems inadvisable.

Due to the mixed nature of many of these tumors the estimation of an adequate dose is difficult.

Teleradium alone was used in 16 previously untreated malignant tumors in this series (12 in the parotid, 3 in the submaxillary gland, 1 in the hard palate). Tumor doses of 3,400 to 7,500 r were given in nine to forty-two days. There was complete resolution of the tumor in 9 of the parotid cases and of the hard palate lesion. In 3 parotid tumors supplementary methods were used, excision in one and radium implantation in two, but in none of these was a favorable result obtained.

Seven cases of local recurrence or metastasis after previous treatment were treated by teleradium. One patient with a benign parotid tumor had remained well for ten years, 2 for five years, and 1 for two years. One recurrent submaxillary gland tumor after receiving 5,000 r in thirty days, recurred again in one year. It was then arrested by implantation and one year later had not reappeared. One submaxillary gland tumor received 3,700 r in fifteen days but cervical node metastases developed after three years and the patient died two years later. One patient with cervical node metastases secondary to basal-cell carcinoma of the soft palate received 4,500 r in thirty days and was still well after three years.

Teleradium was used postoperatively in 2 cases of benign tumor. Both patients were well, one two years and one four years after treatment. Teleradium is rarely used preoperatively, but in one instance a tumor of doubtful operability was rendered operable by this means.

Radium implantation was used as the primary treatment in 4 benign and 6 malignant tumors. The tumor disappeared in 2 of the 4 benign cases after one treatment. Only 1 of the 5 malignant parotid tumors disappeared as the result of treatment. This patient remained well for six years, but ultimately died with recurrence and cervical node metastases. All the others died within two years of treatment. One tumor of the soft palate remained healed for nine years, but cervical node metastasis eventually occurred.

In 8 parotid tumors (7 benign and 1 malignant) postoperative implantation of radium was employed; all the patients were free of recurrence, 4 after more than three years.

SYDNEY J. HAWLEY, M.D.

Treatment of Laryngeal Cancer by Irradiation. D. Quick. Am. J. Roentgenol. **46:** 11–20, July 1941.

Roentgen therapy offers an excellent chance for cure in laryngeal cancer uncomplicated by previous treatment. This method is applicable to a larger group than radical surgery and results in complete restoration of function.

In cases resistant to roentgen irradiation, recurrences, and incompletely treated cases, laryngofissure supplemented by radon implants or cautery offers a chance of cure but without restoration of function except in an occasional case. Metastatic cervical nodes are treated by surgical exposure and radon implantation; their occurrence is infrequent.

The technical factors in an uncomplicated case, that is, one without previous treatment or in imminent need of tracheotomy is as follows: 200 kv.; small fields, up to 4 × 5 cm., two lateral and one anterior; distance 80 cm.; filtration equivalent to 2.32 mm. Cu; 6 to 7 r per minute. The daily dose to the three fields begins with 50 r and is gradually increased to 100 r in the second week. Five treatments are given per week. The total dose is variable, being determined from observation of the patient; 7,500 r is about the minimum safe dosage. The total time is forty to sixty days.

Supportive measures are important. Frequent irrigations and sprays, relief of nasal obstruction, liver extract, vitamin B complex, and a balanced high-caloric diet are a necessity.

This paper supplements an earlier one published in 1937 (Am. J. Roentgenol. **38:** 821, 1937).

S. M. ATKINS, M.D.

Causes of Failure of Roentgen Therapy in Cancer of the Larynx. M. Lenz. Am. J. Roentgenol. **46:** 21–29, July 1941.

Failure to cure cancer of the larynx by roentgen therapy may be due to local causes in the region of the tumor, general causes associated with the inability of the patient to tolerate the treatment, or faulty technic. Among the local causes may be mentioned extensiveness of the growth and invasion of cartilage, as well as deep local infection and necrosis. In the group of general causes may be placed decompensated cardiac disease, chronic alcoholism, and any chronic debilitating disease which reduces the patient's ability to support the unavoidable radiation pharyngitis and laryngitis. Among the technical faults should be listed too intensive daily or too great total dosage and too large fields and, on the other hand, underdosage and inadequate fields.

Of 123 patients treated by roentgen therapy only, 92 are dead, 8 are alive with disease, and 23 are clinically free from cancer. The dosage used in the more recently treated cases is 3,000 to 3,200 r to each of two 6 × 8 cm. lateral laryngeal fields, with 200 kv., 8 to 25 ma., 1 to 2 mm. Cu filter, 50 cm. distance, and 10 to 20 r per minute; total time forty or more days. No cure has resulted where the total dose has been less than 2,700 r per field.

S. M. ATKINS, M.D.

Irradiation in the Treatment of Cancer of the Breast. F. W. O'Brien and E. McDonald. New England J. Med. **226:** 17–20, Jan. 1, 1942.

The use of irradiation exclusively in an operable carcinoma of the breast is justifiable only in those patients who are poor surgical risks, in cases on the borderline of operability, and in specially organized clinics. It is the belief of the authors that surgery is the method of choice in a carcinoma limited to the breast and that 70 per cent of those operated upon can be expected to survive five years. After the growth has extended to the axilla the five-year survival rate drops to 30 per cent in those cases attacked surgically.

The use of preoperative irradiation is advised in an attempt to immobilize tumors of high malignancy and improve the cure rate in this group. Objections have been offered to preoperative irradiation on the ground that it delays operation and also that proof is lacking of its benefit. These objections, however, hold only in part.

Postoperative irradiation should be protracted and sufficiently extensive to cover the chest wall, the axillary and supraclavicular nodes, the mediastinum, the parasternal nodes, and the lymphatics of the other breast. Where the tumor is proved to be localized in the breast, postoperative irradiation is not indicated, but where unsuspected involvement of the axillary nodes is encountered, irradiation should be done. Of 50 consecutive patients with tumors inadequately removed at operation 29 treated by surgery alone lived an average of nine months and none lived as long as five years, whereas 21 treated by both surgery and irradiation lived on an average of over three years, and 5 lived more than five years.

Local recurrence is usually the result of inadequate removal of the growth. In a group of 255 cases of breast cancer, recurrences in the skin or scar occurred in 21 per cent. These small recurrent tumors may be excised if few in number or irradiated with radium or x-rays. Distant bone metastases are readily controlled by irradiation and new bone will form in these areas. Lung and skeletal metastases have been known to regress after sufficient ovarian irradiation to produce castration.

Inoperable breast cancers usually fall to the lot of the radiologist. Much can be done for ulcerating tumors, greatly enlarged lymph nodes, and metastatic lesions. The procedure is purely palliative but does result in comfort to the patient and often prolongs life for one or more years. Careful follow-up examinations and judicious use of sedatives are part of the care of cancer patients.

J. B. McAneny, M.D.

Irradiation Treatment of Carcinoma of the Cervix. H. D. Kerr. Wisconsin M. J. **41:** 34–40, January 1942.

The symptomatology and pathology of carcinoma of the cervix are reviewed briefly. The author then discusses the treatment by irradiation giving his own methods in some detail. Except in very early cases roentgen radiation is given first, followed by radium locally. Both external and transvaginal radiation are employed, the latter being given by the use of an expanding speculum as described by Erskine. Using 133 kv., 2.0 mm. of Al, and a 26 cm. distance, a dose of 1,000 r is given twice a week until a total dose of 5,000 r is reached. Reaction of the mucosa of the cervix and upper vagina following such dosage is similar to that seen in the mouth after intensive treatment. The external treatment is given through eight portals, two portals being treated each day until a total of 15,000 to 20,000 r (in air) has been given. An attempt is made to deliver a total of 5,000 r to the parametrium, and patients are therefore measured carefully and pressure cones are used during treatment. The radium dosage employed is from 5,500 to 6,000 mg. hr. This is given with two tubes in the cervical canal and a plaque of 10 mg. capsules against the cervix. The author believes that the best results in the treatment of these malignant tumors are obtained when complete treatment is given at the first course.

L. W. Paul, M.D.

Pneumoperitoneum as an Aid in Pelvic Irradiation for Carcinoma of the Cervix. L. R. Sante. Am. J. Roentgenol. **46:** 689–699, November 1941.

With pneumoperitoneum and the patient in the Trendelenburg position the intestines may be almost completely displaced from the field of irradiation in cancer of the cervix.

Pneumoperitoneum is produced in the usual fashion and refill is usually unnecessary for at least seven days. Films are taken of the pelvic organs with the roentgen beam directed along the pelvic axis. These films locate the pelvic organs and show the degree of displacement of the intestines.

Four anterior, four posterior, two lateral, and one intravaginal portals are employed for treatment and these must be very accurately outlined, not only as to size but also as to geometric angles in reference to the pelvic organs. With 200 kv., 18 ma., 1 mm. Cu, and 1 mm. Al, 49 r per minute are delivered until a dose of 200 r, measured in air, is administered to all four anterior portals and one lateral portal in a day; the following day the four posterior portals and other lateral portal are treated. The total dose is 2,400 r for a 10 × 10-cm. portal. Cervical and vaginal irradiation with an intracavity cone is carried out during the same period to a total of 1,000 to 1,500 r.

Constitutional reactions even with five external and one vaginal portal daily have failed to develop if the intestines are properly displaced and excluded from irradiation. This displacement has resulted in no rectal tenesmus and no diarrhea.

Report of an Experiment in the Control of Cancer of the Uterus. C. MacFarlane, M. C. Sturgis, and F. S. Fetterman. Pennsylvania M. J. **45:** 348–350, January 1942.

As a test of the value of periodic pelvic examinations, a group of 955 women volunteers between the ages of thirty and eighty-three years have been examined twice a year for two years. In the first 955 examinations, 4 cases of carcinoma were found in apparently early stages. In subsequent examinations, totaling 3,820, no other cases of carcinoma were found, but 471 benign lesions were discovered, of which 291 were thought to be precancerous.

Joseph T. Danzer, M.D.

Treatment of Malignant Tumors of the Testis. G. W. Chamberlain and J. H. Jamison. Am. J. Roentgenol. **46:** 850–865, December 1941.

Forty-five patients with tumor of the testis were seen in the Department of Radiology at the Hospital of the University of Pennsylvania during a twenty-two-year period in which approximately 4,400 cases of malignant diseases of all types were studied. In all but 4 of the patients treated for tumor of the testis histological proof of the malignant nature of the disease was obtained.

Tumors of the testis are classified as follows:

I. Radiosensitive
   - A. Embryonal tumors
     1. Chorionepithelioma
     2. Embryonal carcinoma
     3. Sarcoma
     4. Seminoma

II. Radioresistant
   - A. Adult teratoma
   - B. Dermoid

Painless swelling was the most common symptom re-

lated to the primary tumor. Hematocele, gumma, tuberculosis, and chronic epididymitis are to be considered in differential diagnosis. Roentgenographic examination may be of aid if it shows calcification in the testis due to adult teratoma or dermoid. Excretory urography may give the first evidence of abdominal metastases, showing displacement of the kidney or ureter, or interference with function of the urinary tract. Urinary prolan excretion studies were not always reliable in indicating the degree of malignancy of the tumor or the presence or absence of metastases. In this series 37.7 per cent of the patients had demonstrable metastases when first seen for treatment, and undoubtedly a number of others had metastases not demonstrable.

Patients were divided into three groups. The *first* group included those without demonstrable metastasis when first seen, who were treated preoperatively. Eleven (91 per cent) of the 12 patients in this group are alive, with an average length of life since treatment of 5.2 years. The *second* group consisted of those patients with no demonstrable metastasis when first seen and in whom irradiation was given after orchidectomy. Nine (56 per cent) of the 16 patients in this group are living, with an average length of life for those surviving of 7.5 years. The *third* group was made up of those patients with metastases when first observed for radiation therapy. Only 3 (17 per cent) of the 17 constituting this group are living, 1 for three years and 2 for thirteen years.

From the experience gained in this study and a review of the literature an attempt is made to prepare an ideal course of management for a patient with a primary testicular tumor. This consists of prompt diagnosis based on history and physical examination, prolan studies of the urine, excretory urogram, roentgenogram of the tumor, roentgenograms of the chest, and preoperative irradiation over the lymphatics in the abdomen and then over the tumor. If regression occurs, an orchidectomy should be done in a few weeks and the chest and supraclavicular region should be irradiated after operation. There is no evidence that adult teratomas will be benefited by irradiation.

H. H. WRIGHT, M.D.

Lymphogenous (Lymphatic) Leukemia: Diagnostic, Prognostic, and Therapeutic Considerations Based on an Analysis of Its Morphologic and Clinical Variants. F. H. Bethell. J. A. M. A. **118:** 95–99, Jan. 10, 1942.

Lymphogenous leukemia comprises a group of pathologic states which have as their common attribute disordered and continued proliferation of lymphocyte-forming tissue not limited in response to any recognized irritant or other stimulus and manifested by continuous or intermittent alteration in the lymphocytes of the circulating blood. It is possible to classify patients with lymphogenous leukemia into three main groups on the basis of the type of lymph cell concerned in the process: the lymphoblast, the lymphosarcoma cell, and the lymphocyte. Further subdivision has been made into subleukemic and leukemic states at the time of first observation. In the subleukemic state at least 10 per cent of the circulating white cells exhibit a specific type of abnormality on which the morphologic diagnosis is based, but the total of such cells does not exceed 10,000 per cubic millimeter. In the leukemic state at least 50 per cent of the circulating white cells exhibit the type-specific abnormality, and their total exceeds 10,000 per cubic millimeter. The term subleukemia is used to replace the term pseudoleukemia.

Lymphoblastic leukemia is a cataclysmic disaster of childhood, occurring in the majority of cases in the first decade of life and beginning and terminating in 90 per cent before the age of twenty. Two-thirds of the author's patients were male.

At any period of life lymph tissue may undergo sarcomatous change, and after a variable interval the neoplastic cells may break through the enclosing connective tissue and circulate freely in the blood stream. Males are predominantly affected, and the disease may occur at any age.

Lymphocytic leukemia affects more males than females and occurs almost exclusively in the middle and later years of life.

The author's study is based on 190 cases, of which 52 were of the lymphoblastic, 70 of the lymphosarcoma-cell, and 68 of the lymphocytic type.

The most common early manifestations of lymphoblastic leukemia were symptoms generally referable to anemia, as lassitude, ease of fatigue, and weakness. With both lymphosarcoma-cell and lymphocytic leukemia the most common first sign of disease was enlargement of peripheral lymph nodes or the spleen, usually of the former.

Death occurred within four months in 70 per cent of the cases of lymphoblastic leukemia. The duration of lymphosarcoma-cell leukemia is extremely variable, but nearly one-half of the patients died within one year of the onset of symptoms or the observation of the tumor. The average duration of life in cases of lymphocytic leukemia after the appearance of symptoms was 58.2 months.

Differentiation of lymphogenous leukemia according to the morphologic characteristics of circulating leukemia cells aids in the decision regarding the suitability of roentgen therapy and contributes to the determination of the dose, the number of treatments, and the regions of the body to be irradiated. The experience gained from this series demonstrates the negative and often harmful effects of radiation therapy for lymphoblastic leukemia. This form of treatment should be withheld from patients with this disease.

Roentgen therapy has proved of much greater value in the management of lymphocytic leukemia than the use of arsenicals or any other form of treatment employed. The usual procedure has involved the use of 200 kv. and a dose per treatment of 150 to 200 r measured in air to fields ranging from 10×10 to 15×15 cm. The patient receives a series of daily treatments, usually numbering eight to twelve, applied regionally to the peripheral lymph node areas, the mediastinum, the retroperitoneal region, and the spleen. The indications for therapy are anemia, debility, evidence of increased metabolism, pressure symptoms, and, least important, a progressive rise in the leukocyte count. The interval between courses of therapy is made as long as possible. Ultimate failure of patients to respond to treatment depends not so much on an acquired "refractory" state, brought about by previous therapy, as on the progressive nature of the disease.

Greater caution is needed in the treatment of lymphosarcoma-cell leukemia than in that of lymphocytic leukemia. The results are generally less satisfactory. Localized therapy directed only toward the relief of pressure manifestations is often advisable for such patients, but some derive prolonged benefit from roentgen therapy to all of the major regions of lymphatic tissue. In patients with lymphosarcoma-cell leukemia an exceedingly rapid decrease in the white cell count after irradiation is common and there may be associated severe toxic symptoms.

CLARENCE E. WEAVER, M.D.

Lymphatic Leukemia: Important Facts Additive to Its Clinical and Hematologic Recognition. B. K. Wiseman. J. A. M. A. **118:** 100–105, Jan. 10, 1942.

All the primary non-infectious diseases of the lymphocyte are basically states of leukemia. When definite lymphemia is present, there is little difficulty in identification of the type of lymphoid disorder. Lympho-

sarcoma and lymphatic leukemia without lymphemia are usually identified by recourse to diagnostic measures in addition to a simple peripheral blood examination.

Lymphosarcoma With and Without Lymphemia: Histologically, in the author's clinic, the term lymphosarcoma is confined to lymphoid dyscrasias in which the cell primarily involved can be identified as the lymphocyte and shows morphologic alterations of the neoplastic type. All lymphoid tumors that primarily involve the reticulum cell (including Hodgkin's disease) and the pseudoleukemia of Cohnheim are excluded. When lymphosarcoma is thus restricted, it is the author's experience that all cases of the disease are basically leukemic states, neoplastic in origin and running an acute or subacute course.

Sixty-six cases were studied, 40 in males and 26 in females. The age of the patients ranged from birth to sixty-five years; 43 cases occurred before the age of thirty and 25 before the age of ten years. Almost half of these cases initially showed severe anemia, often without associated adenopathy or splenomegaly. Aspiration of a sample of sternal bone marrow showed most of the marrow tissue replaced by neoplastic lymphocytes but, particularly in the early phases of the disease, there is no detectable invasion of the peripheral blood by these abnormal cell forms. Later, when lymphemia occurs, samples of the peripheral blood show that the increase in white blood cells is due solely to neoplastic lymphocytes. Excessive thrombocytopenia may be the chief early developing feature of this disease, and a mistaken diagnosis of thrombocytopenic purpura may be made. The third most common mode of onset is with abdominal symptoms. Joint pain, bone pain, and "upper respiratory infections" were next most common as the initial clinical features. One patient had a large mediastinal mass which was first observed twelve days before the abnormal lymphocytes were found in the peripheral blood.

The author emphasizes the statement that the diagnosis of this type of leukemia before lymphemia appears is often impossible without recourse to study of the bone marrow. Biopsy is an additional aid when peripheral adenopathy is present.

Lymphatic Leukemia. There is an appreciable amount of data indicating that lymphatic leukemia is neither infectious nor neoplastic. An obscure metabolic origin is suggested as a probability. When lymphemia is present, or specific alteration in the differential count, a diagnostic problem is not usually encountered.

Lymphatic leukemia without lymphemia (type Cohnheim) is the type of lymphoid disease that is usually diagnosed as "lymphosarcoma," "lymphocytoma," "follicular lymphoblastoma," "lymphadenoma," "lymphoma," or "lymphoblastoma." With rare exceptions, the microscopic appearance of the lymphatic tissues is identical with that in lymphatic leukemia with lymphemia, but the white cell count and/or differential count show either no distortions or only minor ones.

The diagnosis of lymphatic leukemia without lymphemia (type Cohnheim) is not difficult. Clinically the important feature is the presence of long-standing adenopathy, generalized and often massive, in a patient without complaints except possibly those due to pressure by some particularly large mass of nodes in the mediastinum (cough and dyspnea) or on a nerve (pain).

Attention is called to the fact that an erythematous, patchy, sometimes macular, sometimes papular, and occasionally typically urticarial pruritic rash on the skin is especially common in this type of lymphatic leukemia. Similar cutaneous lesions occur commonly also in lymphatic leukemia with lymphemia.

Detailed case reports and charts and tables accompany this article, which should be read in the original. A diagrammatic figure depicts the theoretically possible types of reaction of the lymphocyte with the diseases thereby produced. CLARENCE E. WEAVER, M.D.

Clinical Conclusions of Teleroentgentherapy Based on Four Cases Treated at the Radium Institute. C. Gárciga. Rev. méd. cubana **53:** 21–31, January 1942.

Gárciga reports his clinical conclusions on 4 cases treated by teleroentgentherapy at the Radium Institute at Havana, Cuba. In principle the technic is as follows: irradiation of the whole body at a distance of from one to three meters, with a portal approximately 40 × 40 cm. when diminution of the field is desired. Daily doses of 25 r to 50 r are used; 200 kv. with 0.5 mm. Cu filtration. Occasionally the number of treatments is reduced to four a week. The response, as shown by modification of the blood picture, is used as a guide to further treatments. In cases recorded the maximum dose per field was 1,200 r.

The conditions that seem to be most responsive to this form of therapy are leukemia, polycythemia, Hodgkin's disease, lymphosarcoma, and widely disseminated carcinoma. Of the cases reported, 3 were leukemia and 1 Hodgkin's disease. In the leukemic cases favorable results were obtained but this was not true of the case of Hodgkin's disease.

A. MAYORAL, M.D.

Tumors in One of Homologous Twins: Hodgkin's Disease; Osteogenic Sarcoma. H. Charache. Am. J. Roentgenol. **46:** 69–74, July 1941.

Tumors occurring in homologous twins do not always seem to be similar, symmetrical, and simultaneous, although the majority of cases reported in the literature show these characteristics.

Two cases of Hodgkin's disease and one case of osteogenic sarcoma in homologous twins are here described, in which only one of each pair of twins acquired the disease. The homologous living twins are now free from any symptoms and physical findings four years and two months, five and a half, and eight years after the disease was first recognized in the deceased twin. No similar cases could be found in the literature.

S. M. ATKINS, M D

NON-MALIGNANT CONDITIONS

Roentgen Radiation as an Analgesic Agent. J. R. Carty and Lucille Bond. Am. J. Roentgenol. **46:** 532–536, October, 1941.

While the ideal aim of therapy is to correct the underlying pathologic condition, the authors feel that the use of roentgen radiation as a purely analgesic agent has not received the attention it deserves.

Pain may be caused by (*a*) inflammation within the nervous structures themselves, (*b*) inflammation of structures in immediate vicinity of the nerves or nerve endings, (*c*) pressure of neighboring outside structures including scar tissue upon the nerves themselves, (*d*) infiltration of the nerve structures by tumor cells, and (*e*) irritation by trauma.

This study is based on 240 non-malignant cases, and 37 cases of advanced cancer treated solely for pain.

Certain fundamental considerations are set forth: (*a*) quicker and more lasting relief will be obtained in a young than in an old person; (*b*) the earlier the treatment is given the better the result; (*c*) exacerbation of the pain immediately following the first or second treatment is a favorable sign; (*d*) failure to get relief with an adequate series of treatments indicates that the treatment will not succeed and may actually do harm; (*e*) an adequate amount of irradiation is required if satisfactory results are expected (this requires experience); (*f*) too large single doses may do harm, particularly in an infectious process.

Careful selection of cases is necessary to exclude cases of pain on a neurotic basis. Among the conditions treated were superficial infections, sinusitis, herpes zoster, radiculitis, sciatica, cervical neuritis, myositis, painful arthritis, and bursitis, as well as painful malignant neoplasms. Three cases of syringomyelia were treated with unsatisfactory results.

Most of the cases were treated with 200 kv.p., with 1.0 to 2.0 mm. of copper plus 3 mm. aluminum filtration. The total dosages in non-malignant conditions varied from 100 r to 1,200 r (measured in air), depending on the causative factor, and in painful cancer from 1,200 r to 2,000 r.

"Roentgen irradiation is a powerful and effective analgesic agent in many painful conditions. It should be used with discretion and only after much experience."

H. H. WRIGHT, M.D.

Irradiation of the Pituitary Gland in Posterior Lobe Hyperfunction Controlled by Biologic Tests. E. P. Pendergrass, P. J. Hodes, and J. Q. Griffith, Jr. Am. J. Roentgenol. **46:** 673–682, November 1941.

The purpose of this report is to record the authors' experiences in the treatment of hypertension and menstrual headache associated with antidiuretic substance in the blood, not caused by nephritic disease. Forty-one patients were treated, 31 of whom had high blood pressure and 10 symptoms referable to the menopause or menstruation. Antidiuretic studies were carried out during and after irradiation.

The technical factors were as follows: 200 kv.; filter 0.75 mm. Cu and 2 mm. Al; distance 50 cm.; portal 7 cm. in diameter. Two temporal portals are used, one portal being treated daily. The daily dose varied from 50 to 200 r (measured in air, without back-scatter, and applied on the skin). An adequate total dose would appear to be 400 to 500 r. Results should not be evaluated before four to six weeks; a second series of treatments may be given, approximately 1000 r, if no results have followed the first series.

Clinical improvement was obtained in about one-half of the authors' cases, but as the patients have been followed for only four to six months, the permanence of the results cannot be determined. In about two-thirds of the patients positive antidiuretic tests were rendered negative by irradiation of the pituitary.

S. M. ATKINS, M.D.